



H.F. LENZ
COMPANY

COSHOCTON PUBLIC LIBRARY
Coshocton, Ohio

HVAC Upgrades
Air Handling Unit Replacement

Prepared by:

H.F. LENZ COMPANY

1407 SCALP AVENUE
JOHNSTOWN PA, 15904

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Public Notice
To be advertised December 29, 2022 & January 5, 2023

Sealed bids will be received by the Coshocton County District Library Board of Trustees as provided in this notice for its **HVAC Upgrades and Air Handling Unit Replacement Project** at its Main Branch located at 655 Main Street, Coshocton, Ohio 43812. Contract Documents may be obtained from Luke Shumaker, PE at lshumaker@hflenz.com and are on file and available for purchase from Dodge Data & Analytics. All questions should be addressed to Luke Shumaker, PE at lshumaker@hflenz.com by the deadline in the Instructions to Bidders.

Bids shall be enclosed in a sealed envelope addressed to the Coshocton County District Library Board of Trustees, ATTN Kim Eick, Fiscal Officer, Coshocton Public Library – Main Branch, 655 Main Street, Coshocton, Ohio 43812, and plainly marked on the outside "CCDL – HVAC UPGRADES AND AIR HANDLING UNIT REPLACEMENT PROJECT BID." Bids will be received until 12:00 PM, local time February 13, 2023 and immediately after the deadline, the bids will be opened and publicly read in the small meeting room at the Main Branch.

A pre-bid conference will be held on January 17, 2023 at 1:00 PM, at the Main Branch Library, 655 Main Street, Coshocton, Ohio 43812 in the large meeting room.

All bids must include a Bid Guaranty, as described in the Instructions to Bidders. Prevailing wage rates apply. No bidder may withdraw its bid within 60 days after the opening; the Board reserves the right to waive irregularities, reject any or all bids, and conduct necessary investigations to determine bidder responsibility.

INSTRUCTIONS TO BIDDERS

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A. BIDDER'S PLEDGE AND AGREEMENT

1. Each Bidder acknowledges that this is a public project involving public funds and that the Owner expects and requires that each successful Bidder adhere to the highest ethical and performance standards. Each Bidder by submitting a bid pledges and agrees that (a) it will act at all times with absolute integrity and truthfulness in its dealings with the Owner and the Design Professional, (b) it will use its best efforts to cooperate with the Owner and the Design Professional and all other Contractors on the Project and at all times will act with professionalism and dignity in its dealings with the Owner, Design Professional, and other Contractors, (c) it will assign only competent supervisors and workers to the Project, each of whom is fully qualified to perform the tasks that are assigned to him/her, and (d) it has read, understands and will comply with the terms of the Contract Documents.

B. EXAMINATION OF CONTRACT DOCUMENTS AND SITE CONDITIONS AND RELIANCE UPON TECHNICAL DATA

1. Each Bidder shall have a competent person carefully and diligently review each part of the Contract Documents, including the Divisions of the Specifications and parts of the Drawings that are not directly applicable to the Work on which the Bidder is submitting its bid. By submitting its bid, each Bidder represents and agrees, based upon its careful and diligent review of the Contract Documents, that it is not aware of any conflicts, inconsistencies, errors, or omissions in the Contract Documents for which it has not notified the Design Professional in writing at least ten (10) days prior to the bid opening. If there are any such conflicts, inconsistencies, errors, or omissions in the Contract Documents, the Bidder (i) will provide the labor, equipment, or materials of the better quality or greater quantity of Work and/or (ii) will comply with the more stringent requirements. The Bidder will not be entitled to any Change Order, additional compensation, or additional time on account of such conditions for any conflicts, inconsistencies, errors, or omissions that would have been discovered by such careful and diligent review, unless it has given prior written notice to the Design Professional.
2. Each Bidder shall have a competent person carefully and diligently inspect and examine the entire site and the surrounding area, including all parts of the site applicable to the Work for which it is submitting its bid, including location, condition, and layout of the site and the location of utilities, and carefully correlate the results of the inspection with the requirements of the Contract Documents. The Bidder's bid shall include all costs attributable to site and surrounding area conditions that would have been discovered by such careful and diligent inspection and examination of the site and the surrounding area, and the Bidder shall not be entitled to any Change Order, additional compensation, or additional time on account of such conditions.
3. The Bidder may rely upon the general accuracy of any technical data identified in the Owner-Contractor Agreement (e.g., any soils exploration reports, soil boring logs, site survey, or abatement reports) in preparing its bid, but such technical data are not part of the Contract Documents. Except for the limited reliance described in the preceding sentence, Bidder may not, if awarded a contract for the Work, rely upon or make any Claim against the Owner or Design Professional, or any of their agents or employees, with respect to any of the following:
 - (a) the completeness of such reports and drawings for Bidder's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by the successful Bidder and safety precautions and programs incident thereto; or

- (b) any interpretation by the successful Bidder of or conclusion drawn from any technical data or any such other data, interpretations, opinions, or information. For example, all interpolations and extrapolations of data performed by the Bidder to estimate locations or quantities of subsurface strata are independent factual assumptions, which Owner does not warrant.
- 4. Each Bidder will be deemed to have actual knowledge of all information provided or discussed at the pre-bid meeting.

C. PROJECT

- 1. The Project is the HVAC Upgrades and Air Handling Unit Replacement Project (“the Project”) at the existing Main Branch located at 655 Main Street, Coshocton, Ohio 43812. The Project and Work for the Project consists of, but is not limited to, the partial replacement of the existing HVAC, electrical and plumbing systems of the Main Branch building, the installation of a new rooftop air handling unit, and all associated work in accordance with the Drawings and Specifications prepared by the Design Professional.
- 2. The Design Professional for the Project is:

H.F. Lenz Company
1407 Scalp Avenue
Johnston, Pennsylvania 15904
Design Professional Representative: Luke Shumaker, PE
Email: lshumaker@hflenz.com

D. WORK

- 1. Only one contract will be issued by the Owner for constructing the Project, the General Contract, which will cover all scopes of work necessary to construct the Project.
- 2. The Contractor awarded the General Contract (General Contractor) will be responsible for the performance and coordination of any and all subcontractors and suppliers either directly or indirectly contracted with the General Contractor.
- 3. Owner may provide Bidders access to the Project site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations and Owner’s policies relative to excavation and utility locates. Bidders must follow COVID-19 safety protocols required by law or requested by the Owner. Other than the pre-bid meeting, bidders may visit the Project site from the general public’s perspective (no questions to staff are permitted) or set an appointment Jennifer Austin, Director, at jaustin@coshoctonlibrary.org to visit the Project site. All questions must be submitted in writing per Paragraph M, below.

E. ESTIMATE OF COST

The total estimated construction cost for the base bid is **\$501,600.00**.

F. CONTRACT DOCUMENTS AND PRE-BID MEETING

- 1. The Contract Documents consist of the Contract Documents listed in Section 1 of the Owner-Contractor Agreement.
- 2. Electronic copies of the Contract Documents may be obtained from Luke Shumaker, PE at lshumaker@hflenz.com and are on file and available for purchase at Bidder’s cost from Dodge Data & Analytics.

3. Bidders shall use complete sets of Contract Documents in preparing bids. Neither the Owner nor the Design Professional assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.
4. The Owner or the Design Professional, in making the Contract Documents available on the above terms, does so only for the purpose of obtaining bids on the Work and does not confer a license or grant for any other use.
5. A pre-bid conference will be held January 17, 2023 at 1:00 PM at the Main Branch Library, 655 Main Street, Coshocton, Ohio 43812 in the large meeting room.

Attendance is highly recommended. The Owner shall not be held liable if a bidder is unable to attend due to technical or other issues or obstructions.

G. PREPARATION OF BIDS

1. All bids must be submitted on the "Bid Form" furnished with the Contract Documents.
2. All blank spaces shall be filled in, in ink or typewritten, in words and figures, and in figures only where no space is provided for words, and signed by the Bidder. The wording on the Bid Form shall be used without change, alteration, or addition. Any change in the wording or omission of specified accompanying documents may cause the bid to be rejected. If there is an inconsistency or conflict in the bid amount, the lowest amount shall control, whether expressed in numbers or words.
3. Bidders shall note receipt of Addenda on the Bid Form. If the Bidder fails to acknowledge receipt of each Addendum, the Bid shall be deemed non-responsive, unless the Bid amount clearly and unambiguously reflects receipt of the Addendum or the Addendum involves only a matter of form and does not materially affect the price, quantity or quality of the Work to be performed.
4. Each Bidder shall submit **1 original and 1 copy** of its bid to the Owner. The Bid Form shall be signed with the name typed or printed below the signature. A Bid shall not be submitted by facsimile transmission or any other electronic means. A Bidder that is a corporation shall sign its bid with the legal name of the corporation followed by the name of the state of incorporation and the legal signature of an officer authorized to bind the corporation to a contract.
5. Bids shall be enclosed in a sealed opaque envelope with the Bidder's name, plainly marked on the outside "CCDL – HVAC UPGRADES AND AIR HANDLING UNIT REPLACEMENT PROJECT BID," and addressed as follows:

**Coshocton County District Library Board of Trustees
ATTN: Kim Eick, Fiscal Officer
655 Main Street
Coshocton, Ohio 43812**

Bids must be received at the location designated above before **12:00 P.M., local time February 13, 2023.**

Hand deliveries to the Main Branch Library location (655 Main Street, Coshocton, Ohio 43812) are preferred. Hand deliveries may be made Monday-Friday between 10:00 a.m. and 4:00 p.m. and must be made before the deadline. However, Respondents are responsible for confirming current operating/office hours.

A public bid opening will take place immediately after the time for submitting bids is expired. Bidders may attend in person at the Small Meeting Room of the Main Branch Library.

The Owner shall not be held liable if a bidder is unable to attend due to technical or other issues or obstructions.

6. **The completed Bid Form shall be accompanied by the following completed documents:**
 - Bid Guaranty and if applicable, Contract Bond (See Paragraph G.8 below.)**
 - Contractor's Qualification Statement (See Paragraph H.4 below.)**
7. The Bidder shall take the following precautions in preparing its bid:
 - a. Sign the bid and check to ensure all blank spaces have been filled in with requested information and that the specified accompanying documents (listed in Paragraph G.6 above) have been included in a sealed opaque envelope addressed as described in item Paragraph G.5 above.
 - b. When the Bid Form provides for quoting either an addition or deduction for an Alternate item, indicate whether the sum named is an addition or deduction. If it is not indicated, it will be conclusively presumed that the amount is a deduction.
 - c. When the Bid Form provides for quoting a unit price, the Bidder should quote the unit price as set forth in the Contract Documents and as described in Paragraph L.1 below.
 - d. When applicable, make sure that the Bid Guaranty is properly executed and signed by:
 - 1) The Bidder
 - 2) The Surety or Sureties
 - e. Make sure that the amount of the Bid Guaranty (if the Bid Guaranty is in the form of a certified check, letter of credit, or cashier's check) is for a specific sum in an amount as instructed in Paragraph G.8.a below. If the Bid Guaranty is in the form of the Bid Guaranty and Contract Bond, the amount may be left blank; if an amount is inserted, it must equal the total of the base bid plus the amount of all add alternates included in the bid. If inserted, then the failure to state an amount equal to the total of the base bid and all add alternates shall make the bid non-responsive if the Owner selects alternates not included in the amount.
 - f. Make sure that the appropriate bid package and scope of work is inserted in the correct space on the Bid Guaranty and Contract Bond Form. Failure to include work covered by the bid submitted may make the bid non-responsive.
8. Bonds and Guarantees
 - a. **Bid Guaranty:** Bidder shall furnish a Bid Guaranty, in the form prescribed in Sections 153.54, 153.57, and 153.571 of the Ohio Revised Code, in the form of either: (1) a bond for the full amount of the Base Bid plus the amount of all Add Alternates included in the Bidder's bid, in the form of the Bid Guaranty and Contract Bond included in the Contract Documents; or (2) a certified check, cashier's check, or irrevocable letter of credit in a form satisfactory to the Owner in an amount equal to 10% of the bid. Bid amount shall be the total of all sums bid, including all add alternatives, but excluding all deduct alternatives. NOTE: AIA or EJCDC Bid Bond forms are not acceptable.
 - b. **Contract Bond:** The successful Bidder, who, as a Bid Guaranty, submits a certified check, cashier's check, or irrevocable letter of credit in an amount equal to 10% of the bid, shall furnish a Contract Bond in the form Contract Bond included in the Contract Documents in an amount equal to 100% of the Contract Sum. NOTE: AIA or EJCDC Bond forms are not acceptable.

- c. The bond must be issued by a surety company authorized by the Ohio Department of Insurance to transact business in the State of Ohio and acceptable to the Owner. The bond must be issued by a surety capable of demonstrating a record of competent underwriting, efficient management, adequate reserves, and sound investments. These criteria will be deemed to be met if the surety currently has an A.M. Best Company Policyholders Rating of "A-" or better and has or exceeds the Best Financial Size Category of Class VI. Other sureties may be acceptable to the Owner, in its sole discretion
- d. All bonds shall be signed by an authorized agent of an acceptable surety and by the Bidder.
- e. Surety bonds shall be supported by credentials showing the Power of Attorney of the agent, a certificate showing the legal right of the Surety Company to do business in the State of Ohio, and a financial statement of the Surety.
- f. The Bid Guaranty, as applicable, shall be in the name of or payable to the order of the Owner.
- g. The name and address of the Surety and the name and address of the Surety's Agent should be typed or printed on each bond.

H. METHOD OF AWARD

1. **All bids shall remain open for acceptance for sixty (60) days** following the day of the bid opening, but the Owner may, in its sole discretion, release any bid and return the Bid Guaranty prior to that date. The Bid Guaranty shall be subject to forfeiture, as provided in the Ohio Revised Code, if a bid is withdrawn during the period when bids are being held.
2. The Owner reserves the right to reject any, part of any, or all bids and to waive any informalities and irregularities. The Bidder expressly acknowledges this right of the Owner to reject any or all bids or to reject any incomplete or irregular bid. Bidders must furnish all information requested on or accompanying the Bid Form. Failure to do so may result in disqualification of the bid.
3. Determination of the Lowest Responsible Bid. Subject to the right of the Owner to reject any or all bids, the Owner will award the Contract for the Work to the bidder submitting the lowest responsible bid that is responsive to the bidding requirements, taking into consideration accepted alternates. In evaluating bids, the Owner may consider the qualifications of the Bidders, whether or not the bids comply with the prescribed requirements, and alternates and unit prices, if requested, on the Bid Form. The Owner may also consider the qualifications and experience of subcontractors and suppliers. The Owner may conduct such investigations as are deemed necessary to establish the qualifications and financial ability of the Bidder and its subcontractors and suppliers. The factors the Owner may consider in determining which bid is the lowest responsible include the factors set forth below. The Owner, in its discretion, may consider and give such weight to these criteria as it deems appropriate.
 - a. The Bidder's work history. The Bidder should have a record of consistent customer satisfaction and of consistent completion of projects, including projects that are comparable to or larger and more complex than the Owner's Project, on time and in accordance with the applicable Contract Documents, and based upon the Bidder's claims history. If the Bidder's management operates or has operated another construction company, the Owner may consider the work history of that company in determining whether the Bidder submitted the lowest responsible bid.

The Owner will consider the Bidder's prior experience on other projects of similar scope and/or complexity including prior projects with the Owner and/or Design Professional, including the Bidder's demonstrated ability to complete its work on these projects in accordance with the Contract Documents and on time, and will also consider its ability to work with the Owner and Design Professional as a willing, cooperative, and successful team member. Bringing overstated claims, an excessive number of claims, acting

uncooperatively, and filing lawsuits against project owners and/or their design professionals on prior projects of similar scope and/or complexity will be deemed evidence of a Bidder's inability to work with the Owner and Design Professional as a willing, cooperative, and successful team member.

The Bidder authorizes the Owner and its representatives to contact the owners and design professionals (and construction managers, if applicable) on projects on which the Bidder has worked and authorizes and requests such owners and design professionals (and construction managers) to provide the Owner with a candid evaluation of the Bidder's performance. By submitting its bid, the Bidder agrees that if it or any person, directly or indirectly, on its behalf or for its benefit brings an action against any of such owners or design professionals (or construction managers) or the employees of any of them as a result of or related to such candid evaluation, the Bidder will indemnify and hold harmless such owners, design professionals (and construction managers) and the employees of any of them from any claims, whether or not proven, that are part of or are related to such action and from all legal fees and expenses incurred by any of them arising out of or related to such legal action. This obligation is expressly intended for the benefit of such owners, design professionals (and construction managers), and the employees of each of them.

- b. The Bidder's financial ability to complete the Contract successfully and on time without resort to its Surety.
 - c. The Bidder's prior experience with similar work on comparable or more complex projects.
 - d. The Bidder's prior history for the successful and timely completion of projects, including the Bidder's history of filing claims and having claims filed against it.
 - e. The Bidder's equipment and facilities.
 - f. The adequacy, in numbers and experience, of the Bidder's work force to complete the Contract successfully and on time.
 - g. The Bidder's compliance with federal, state, and local laws, rules, and regulations, including but not limited to the Occupational Safety and Health Act, the Ohio Prevailing Wage laws, and Ohio ethics laws.
 - h. The Bidder's participation in a drug-free workplace program acceptable to the Owner, and the Bidder's record for both resolved and unresolved findings of the Auditor of State for recovery as defined in Section 9.24 of the Ohio Revised Code.
 - i. The Owner's prior experience with the Bidder's surety.
 - j. The Bidder's interest in the Project as evidenced by its attendance at any pre-bid meetings or conferences for bidders.
 - k. Depending upon the type of the work, other essential factors, as the Owner may determine and as are included in the Specifications.
 - l. The number of years the Bidder has been actively engaged as a contractor in the construction industry.
 - m. Financial responsibility demonstrated by the Bidder and whether Bidder possesses adequate resources and availability of credit, the means and ability to procure insurance and acceptable performance bonds required for the Project and whether any claims have been made against performance bonds secured by the bidder on other construction projects.
 - n. The foregoing information with respect to each of the Subcontractors and Suppliers that the Bidder intends to use on the Project.
4. **Qualifications Statement. Each Bidder will submit with its bid a completed Contractor Qualifications Statement, which is included with the Contract Documents, and thereafter provide the Design Professional promptly with such additional information as the**

Design Professional may request regarding the Bidder's qualifications. A Bidder shall submit any requested additional information within 24 hours of the date on the request.

5. The failure to submit requested information on a timely basis may result in the determination that the Bidder has not submitted the lowest responsible bid.
6. By submitting its bid, the Bidder agrees that the Owner's determination of which bidder is the lowest responsible bidder shall be final and conclusive, and that if the Bidder or any person on its behalf challenges such determination in any legal proceeding, whether or not proven, the Bidder will indemnify and hold the Owner and its employees and agents harmless from any claims included or related to such legal proceeding, whether or not proven, and from legal fees and expenses incurred by the Owner, its employees, or agents that arise out of or are related to such challenge.
7. **After bid opening, within 24 hours of a request made by the Owner or Design Professional, the apparent low Bidder and any other Bidder so requested must submit the following:**

- a. **SUBCONTRACTORS:** For all subcontracts with an estimated value of at least \$20,000, a list of all Subcontractors that the Bidder will use to construct the Project, as well as an indication of whether or not the Bidder has ever worked with a proposed Subcontractor before, including the following information for the three most recent projects on which the Bidder and each Subcontractor have worked together:

- Project Owner
- Project Name
- Subcontract Scope
- Subcontract Value
- Owner's contact name and phone number.

If Bidder and a proposed Subcontractor have not worked together on at least three projects in the five years, Bidder must submit the information set forth above for the three most recent similar projects to the Project that a proposed Subcontractor has worked on.

The above Subcontractor information, as well as the information pertaining to each proposed Subcontractor, shall be used in the Owner's determination of the lowest responsible bid.

Once a Bidder identifies its proposed Subcontractors as set forth herein, and Owner makes no objections, the list shall not be changed unless written approval of the change is authorized by the Owner and Design Professional.

- b. **FINANCING: The following additional financial information is not a public record under Ohio Revised Code Section 149.43 and will be kept confidential, except under proper order of a court, per Ohio Revised Code Section 9.312(A).**

i. Provide a financial statement, preferably audited, including your organization's latest balance sheet and income statement showing the following items:

- Current Assets (e.g., cash, joint venture accounts, accounts receivable, notes receivable, accrued income, deposits, materials inventory and prepaid expenses);

- Net Fixed Assets;
- Other Assets;
- Current Liabilities (e.g., accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries and accrued payroll taxes); and
- Other Liabilities (e.g., capital, capital stock, authorized and outstanding shares par values, earned surplus and retained earnings).

ii. Provide the name and address of firm preparing attached financial statement, and date thereof.

iii. If the attached financial statement is not for the identical organization named in the completed Contractor's Qualification Statement submitted with the bid, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent-subsiary).

8. Affidavit as to Personal Property Taxes. Each successful Bidder shall submit, prior to the time of the entry into the Contract, an affidavit in the form required by Section 5719.042, Ohio Revised Code, regarding the status of the Bidder's personal property taxes. A copy of the affidavit form is included with the Contract Documents.
9. No Bidder may withdraw its bid within **sixty (60)** days after the date bids are opened. The Owner reserves the right to waive any formalities or irregularities or to reject any or all bids.
10. The Owner reserves the right to disqualify bids, before or after opening, upon evidence of collusion with intent to defraud or other illegal practices on the part of the Bidder.
11. Award of Contract. The award of the Contract, when required, will only be made pursuant to a duly adopted resolution of the Owner.

I. EXECUTION OF CONTRACT

1. Within the time designated by the Owner or Design Professional after award of the Contract, the successful Bidder shall execute and deliver to the Owner or Design Professional the required number of copies of the Owner-Contractor Agreement, in the form included in the Contract Documents, and all accompanying documents requested, including, but not limited to, a Contract Bond (if applicable), insurance certificates, and a valid Workers' Compensation Certificate. The successful Bidder shall have no property interest or rights under the Owner-Contractor Agreement until the Agreement is executed by the Owner.

J. SUBSTITUTIONS/NON-SPECIFIED PRODUCTS

1. Certain brands of material or apparatus are specified. Each bid will be based on these brands, which may be referred to in the Contract Documents as Standards. The use of another brand (referred to as a substitution or proposed equal in the Contract Documents, when a bidder or the contractor seeks to have a different brand of material or apparatus than that specified approved by the Owner for use in the Project) may be requested as provided herein.
2. The products specified in the Contract Documents establish a standard of required function, dimension, appearance, and quality.
3. Bidders wishing to obtain approval to bid non-specified products shall submit written requests to the Design Professional a minimum of ten (10) calendar days before the bid date and hour. To facilitate the submission of requests, a Pre-Bid Substitution Form is included in the Contract Documents. The Bidder shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution, including the name of the proposed manufacturer and/or product and a complete description of the proposed product

including the manufacturer's name and model number or system proposed, drawings, product literature, performance and test data, color selections or limitations, and any other information necessary for evaluation. Include a statement including any changes in other materials, equipment, or other work that would be required if the proposed product is incorporated in the materials, equipment, or other work that would be required if the proposed product is incorporated in the work. The burden of proof of the merit of the proposed product is on the proposer. The Design Professional's decision on approval of a proposed product will be final.

The following will be cause for rejection of a proposed substitution:

- a. Requests submitted by subcontractors, material suppliers, and individuals other than Bidders;
 - b. Requests submitted without adequate documentation;
 - c. Requests received after the specified cut-off date.
4. When the Design Professional approves a product submission before receipt of bids, the approval will be included in an Addendum, and Bidders may include the pricing of this product in their bid. Bidders shall not rely on approvals made in any other manner.
 5. In proposing a non-specified product or a substitution, the Bidder represents and warrants that each proposed product will not result in any changes to the Project, including changes to the Work of other contractors, or any decrease in the performance of any equipment or systems to be installed in the Project and agrees to pay any additional costs incurred by the Owner and the Owner's consultants as a result of a non-specified or substitute product that is accepted.
 6. Following the award of the Contract, there shall be no substitutions for specified products, except pursuant to a Change Order. The Owner in its sole discretion may decline to consider a substitution for a Change Order.

K. ALTERNATES

1. The Owner may request bids on alternates. If the Owner requests bids on alternates, the Bidder should include the cost of the alternates requested on its Bid Form.
2. At the time of awarding the Contract, the Owner will select or reject alternates as it determines is in its best interest. A Bidder's failure to include on its Bid Form the cost of an alternate selected by the Owner and applicable to the Bidder's work shall render the bid non-responsive and be grounds for the rejection of the bid. Otherwise, the failure to include the cost of an alternate will not be deemed material.
3. The Bidder acknowledges that although there is an estimate for the cost of the Project, the market conditions may and frequently do result in the estimate being different from the sum of the bids received, either higher or lower. The Bidder understands that the Owner may include alternates, which may include deduct alternates as well as add alternates, to give it flexibility to build the Project with the funds available. The Bidder further understands and acknowledges that use of add and deduct alternates is a long held customary practice in the construction industry in the State of Ohio. The Bidder also acknowledges that the Owner will not make a decision about the alternates on which to base the award of contracts until the bids are received, and the Owner can compare its available funds with the base bids and the cost or savings from selecting different alternates. The Bidder understands that the award to the Bidder submitting the lowest responsible bid will be based on the lowest base bid plus selected alternates, and may result in an award to a Bidder other than the Bidder that submitted the lowest base bid.
4. If, during the progress of the Work, the Owner desires to reinstate any alternate not included in the Contract, the Owner reserves the right to reinstate the alternate at the price bid by the Contractor provided that such action is taken in sufficient time so as not to delay the progress of the work or cause the Contractor additional expense.

L. UNIT PRICES

1. Where unit prices are requested in the Bid Form the Bidder should quote a unit price. Unless otherwise expressly provided in the Contract Documents, such unit prices shall include all labor, materials, and services necessary for the timely and proper installation of the item for which the unit prices are requested as well as all expenses and costs for overhead and profit. The unit prices quoted in the bid shall be the basis for any Change Orders entered into under the Owner-Contractor Agreement, unless the Design Professional determines that the use of such unit prices will cause substantial inequity to either the Contractor or the Owner.

M. ADDENDA

1. The Owner reserves the right to issue Addenda changing, altering, or supplementing the Contract Documents prior to the time set for receiving bids. The Design Professional will issue the Addenda to clarify bidders' questions and/or to change, alter, or supplement the Contract Documents.
2. Any explanation, interpretation, correction, or modification of the Contract Documents will be issued in writing in the form of an Addendum, which shall be the only means considered binding; explanations, interpretations, etc., made by any other means shall NOT be legally binding. All Addenda shall become a part of the Contract Documents.
3. Bidders shall submit written questions to Luke Shumaker, PE, H.F. Lenz Company, at lshumaker@hflenz.com by **12 Noon, February 6, 2023** to allow sufficient time for the Design Professional to respond. All Addenda will be issued, except as hereafter provided, and e-mailed or otherwise furnished to persons who have obtained Contract Documents for the Project, at least seventy-two (72) hours prior to the published time for the opening of bids, excluding Saturdays, Sundays, and legal holidays. If any Addendum is issued within such seventy-two (72) hour period, then the time for opening of bids shall be extended one (1) week with no further advertising of bids required.
4. Copies of each Addendum will be sent only to the Bidders to whom Contract Documents have been issued and to Plan Rooms where copies of the Contract Documents are maintained. Receipt of Addenda shall be indicated by Bidders in the space provided on the Bid Form. Bidders are responsible for acquiring issued Addenda in time to incorporate them into their bid. Bidders should contact the Design Professional prior to the bid opening to verify the number of Addenda issued.
5. Each Bidder shall carefully read and review the Contract Documents and immediately bring to the attention of the Design Professional any error, omission, inconsistency, or ambiguity therein.
6. If a Bidder fails to indicate receipt of all Addenda through the last Addendum issued by the Design Professional on its Bid Form, the bid of such Bidder will be deemed to be responsive only if:
 - a. The bid received clearly indicates that the Bidder received the Addendum, such as where the Addendum added another item to be bid upon and the Bidder submitted a bid on that item; or
 - b. The Addendum involves only a matter of form or is one which has either no effect or has merely a trivial or negligible effect on price, quantity, quality, or delivery of the item bid upon.

N. INTERPRETATION

1. If a Bidder contemplating submitting a bid for the proposed Project is in doubt as to the true meaning of any part of the Contract Documents, it may submit a written request for an interpretation thereof to Luke Shumaker, PE, H.F. Lenz Company, at lshumaker@hflenz.com **by the deadline for questions per paragraph M.3 above**. Any interpretation of the proposed documents will be made by Addendum only, duly signed by the Design Professional, and a copy of such Addendum will be mailed or delivered to each Bidder receiving a set of Contract

Documents and each plan room where the Contract Documents are maintained. The Owner will not be responsible for any other explanation or interpretation of the proposed documents.

2. In interpreting the Contract Documents, words describing materials that have a well-known technical or trade meaning, unless otherwise specifically defined in the Contract Documents, shall be construed in accordance with the well-known meaning recognized by the trade.
3. Bidders are responsible for notifying the Owner and the Design Professional in a timely manner of any ambiguities, inconsistencies, errors, or omissions in the Contract Documents. The Bidder shall not, at any time after the execution of the Contract, be compensated for a claim alleging insufficient data, incomplete Contract Documents, or incorrectly assumed conditions regarding the nature or character of the Work, if no request was made by the Bidder prior to the bid opening.

O. STATE SALES AND USE TAXES

1. The Owner is a political subdivision of the State of Ohio and is exempt from taxation under the Ohio Sales Tax and Use Tax Laws. Building materials that the successful Bidder purchases for incorporation into the Project will be exempt from state sales and use taxes if the successful Bidder provides a properly completed Ohio Department of Taxation Construction Contract Exemption Certificate to the vendors or suppliers when the materials are acquired. The Owner will execute properly completed certificates on request.

P. DATE FOR SUBSTANTIAL COMPLETION/ DATE FOR FINAL COMPLETION /LIQUIDATED DAMAGES

1. The Date for Substantial Completion (aka Contract Time), Date for Final Completion, and Liquidated Damages shall be as defined and set forth in the Owner-Contractor Agreement. **By submitting its Bid, each Bidder agrees that the period for performing its Work is reasonable.**

Q. OWNER'S RIGHT TO WAIVE DEFECTS AND IRREGULARITIES

1. The Owner reserves the right to waive any and all irregularities provided that the defects and irregularities do not affect the amount of the bid in any material respect or otherwise give the Bidder a competitive advantage.

R. MODIFICATION/WITHDRAWAL OF BIDS

1. Modification. A Bidder may modify its bid by written communication to the Owner addressed to the Owner's Representative at any time prior to the scheduled closing time for receipt of bids, provided such written communication is received by Owner's Representative prior to the bid deadline. The written communication shall not reveal the bid price, but should provide the addition or subtraction or other modification so that the final prices or terms will not be known until the sealed bid is opened. If the Bidder's written instructions with the change in bid reveal the bid amount in any way prior to the bid opening, the bid may be rejected as non-responsive.
2. Withdrawal Prior to Bid Deadline. A Bidder may withdraw its bid at any time for any reason prior to the bid deadline for the opening of bids. The request to withdraw shall be made in writing to and received by the Owner prior to the time of the bid opening.
3. Withdrawal after Bid Deadline.
 - a. All bids shall remain valid and open for acceptance for a period of at least 60 days after the bid opening; provided, however, that a Bidder may withdraw its bid from consideration after the bid deadline when all of the following apply:
 - (1) the price bid was substantially lower than the other bids;
 - (2) the reason for the bid being substantially lower was a clerical mistake, rather than a mistake in judgment, and was due to an unintentional and substantial error in arithmetic or an unintentional omission of a substantial quantity of work, labor, or material;

- (3) the bid was submitted in good faith; and
 - (4) the Bidder provides written notice to the Owner, to the attention of the Owner's Representative, within two (2) business days after the bid opening for which the right to withdraw is claimed.
- b. No bid may be withdrawn under this provision if the result would be the awarding of the contract on another bid for the bid package from which the Bidder is withdrawing its bid to the same Bidder.
 - c. If a bid is withdrawn under this provision, the Owner may award the Contract to another Bidder determined by the Owner to be the lowest responsible bidder or the Owner may reject all bids and advertise for other bids. In the event the Owner advertises for other bids, the withdrawing Bidder shall pay the costs incurred in connection with the rebidding by the Owner, including the cost of printing new Contract Documents, required advertising, and printing and mailing notices to prospective bidders, if the Owner finds that such costs would not have been incurred but for such withdrawal.

S. COMPLIANCE WITH APPLICABLE LAWS

- 1. By submitting a bid for Work on the Project, the Bidder acknowledges that it is in compliance with applicable federal, state, and local laws and regulations, including, but not limited to, the following:
 - a. Equal Employment Opportunity/Nondiscrimination. The Bidder agrees that if it is awarded a contract that in the hiring of employees for performance of work under the contract or any subcontract, neither it nor any subcontractor, or any person acting on its behalf or its subcontractor's behalf, by reason of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color, shall discriminate against any citizen of the state in the employment of labor or workers who are qualified and available to perform work to which the employment relates. The Bidder further agrees that neither it nor any subcontractor or any person on its behalf or on behalf of any subcontractor, in any manner, shall discriminate against or intimidate any employees hired for the performance of the work under the contract on account of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color.
 - b. Ethics Laws. The Bidder represents that it is familiar with all applicable ethics law requirements, including without limitation Sections 102.04 and 3517.13 of the Ohio Revised Code, and certifies that it is in compliance with such requirements.

T. FINDINGS FOR RECOVERY

- 1. By submitting its bid, each Bidder certifies for reliance of the Owner that it has no unresolved finding for recovery against it issued by the Auditor of the State of Ohio on or after January 1, 2001, except as permitted by Section 9.24 (F) of the Ohio Revised Code.

U. PREVAILING WAGES

- 1. The successful Bidder and all of its subcontractors, regardless of tier, will strictly comply with its obligation to pay a rate of wages on the Project not less than the rate of wages fixed for this Project under Section 4115.04 of the Ohio Revised Code. Additionally, the successful Bidder will comply with all other provisions of Chapter 4115 of the Ohio Revised Code.

END OF INSTRUCTIONS TO BIDDERS

BID FORM

1.01 BID SUBMITTED BY:

(Contractor)
Date bid submitted: _____

1.02 DELIVER TO:

**Coshocton County District Library Board of Trustees
ATTN: Kim Eick, Fiscal Officer
Main Branch Library
655 Main Street
Coshocton, Ohio 43812**

1.03 Having carefully reviewed the Instructions to Bidders, Drawings, Specifications and other Contract Documents for the Project titled **HVAC Upgrades and Air Handling Unit Replacement Project** including having also received, read, and taken into account the following Addenda:

| Addendum No. | Dated |
|--------------|-------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

and likewise having inspected the site and the conditions affecting and governing the Project, the undersigned hereby proposes to furnish all materials and to perform all labor, as specified and described in the said Specifications and/or as shown on the said Drawings for all Work necessary to complete the Project on a timely basis and in accordance with the Contract Documents regardless of whether expressly provided for in such Specifications and Drawings.

1.04 Before completing the Bid Form, the undersigned represents that it has carefully reviewed the Request for Bids, Instructions to Bidders, this Bid Form, Form of Bid Guaranty and Contract Bond, Contractor's Affidavit (O.R.C. 5719.042), Owner-Contractor Agreement (OWNER-CONTRACTOR AGREEMENT & AIA A201-2017 GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION as modified for the Project), Drawings, Project Specifications, and other Contract Documents. Failure to comply with provisions of the Contract Documents may be cause for disqualification of the bid.

1.05 BONDS AND CONTRACT: If the undersigned is notified of bid acceptance, it agrees to furnish required bonds as indicated in the Instructions to Bidders.

1.06 COMPLETION OF WORK: In submitting a bid, the undersigned agrees to execute the Owner-Contractor Agreement in the form included in the Contract Documents and to complete its Work as required by the Contract Documents.

NOTE A: The wording of the Bid Form shall be used throughout, without change, alteration, or addition. Any change may cause it to be rejected.

NOTE B: Bidder is cautioned to bid only on the Brands or Standards specified.

NOTE C: If there is an inconsistency or conflict in the Bid amount, the lowest amount shall control, whether expressed in numbers or words.

2.01 BID:

Include the cost of all labor and material for the contract listed below. Bidder is to fill in all blanks related to the Bid Package for which a bid is being submitted. If no bid is submitted for an item, leave the item blank or insert "NO BID" in the blank. For alternate items, indicate whether the amount stated is in addition to or a deduction from the base bid amount (if there is no indication whether the amount for an alternate is an addition or a deduction, the amount shall be a deduction).

2.02 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Lump Sum – All Work, including Allowances, if any, but not including Alternates.

_____ Dollars (\$ _____)
(Words) (Figures)

3.01 INSTRUCTIONS FOR SIGNING

- A. The person signing for a sole proprietorship must be the sole proprietor or his authorized representative. The name of the sole proprietor must be shown below.
- B. The person signing for a partnership must be a partner or his authorized representative.
- C. The person signing for a corporation must be the president, vice president or other authorized representative; or he must show authority, by affidavit, to bind the corporation.
- D. The person signing for some other legal entity must show his authority, by affidavit, to bind the legal entity.

4.01 BIDDER CERTIFICATIONS. The Bidder hereby acknowledges that the following representations in this bid are material and not mere recitals:

1. **The Bidder acknowledges that this is a public project involving public funds, and that the Owner expects and requires that each successful Bidder adhere to the highest ethical and performance standards. The Bidder by submitting its bid pledges and agrees that (a) it will act at all times with absolute integrity and truthfulness in its dealings with the Owner and the Design Professional, (b) it will use its best efforts to cooperate with the Owner and the Design Professional and all other Contractors on the Project and at all times will act with professionalism and dignity in its dealings with the Owner, Design Professional and other Contractors, (c) it will assign only competent supervisors and workers to the Project, each of whom is fully qualified to perform the tasks that are assigned to him/her, and (d) it has read, understands and will comply with the terms of the Contract Documents.**
2. The Bidder represents that it has had a competent person carefully and diligently review each part of the Contract Documents, including any Divisions of the Specifications and parts of the Drawings that are not directly applicable to the Work on which the Bidder is submitting its bid. By submitting its bid, each Bidder represents and agrees, based upon its careful and diligent review of the Contract Documents, that it is not aware of any conflicts, inconsistencies, errors or omissions in the Contract Documents for which it has not notified the Design Professional in writing at least seven (7) days prior to the bid opening. If there are any such conflicts, inconsistencies, errors or omissions in the Contract Documents, the Bidder (i) will provide the labor, equipment or materials of the better quality or greater quantity of Work; and/or (ii) will comply with the more stringent requirements. The Bidder will not be entitled to any additional compensation for any conflicts, inconsistencies, errors or omissions that would have been discovered by such careful and diligent review, unless it has given such prior written notice to Design Professional.
3. The Bidder represents that it has had a competent person carefully and diligently inspect and examine the entire site for the Project and the surrounding area, including all parts of the site applicable to the Work for which it is submitting its bid, and carefully correlate the results of the

inspection with the requirements of the Contract Documents. The Bidder agrees that its bid shall include all costs attributable to site and surrounding area conditions that would have been discovered by such careful and diligent inspection and examination of the site and the surrounding area, and the Bidder shall not be entitled to any Change Order, additional compensation, or additional time on account of conditions that could have been discovered by such an investigation.

4. The Bidder represents, understands and agrees that a) the Claim procedures in the General Conditions as modified for the Project are material terms of the Contract Documents, b) if it has a Claim, it will have its personnel provide complete and accurate information to complete and submit the Statement of Claim form on a timely basis, c) the proper completion and timely submission of a Statement of Claim form is a condition precedent to any change in the Contract Sum or the Contract Time(s), and d) the proper and timely submission of the Statement of Claim form provides the Owner and the Design Professional with necessary information so that the Owner may investigate the Claim and mitigate its damages.
5. The Bidder represents that the bid contains the name of every person interested therein and is based upon the Standards specified by the Contract Documents.
6. The Bidder and each person signing on behalf of the Bidder certifies, and in the case of a bid by joint venture, each member thereof certifies as to such member's entity, under penalty of perjury, that to the best of the undersigned's knowledge and belief: (a) the Base Bid, any Unit Prices and any Alternate bid in the bid have been arrived at independently without collusion, consultation, communication or agreement, or for the purpose of restricting competition as to any matter relating to such Base Bid, Unit Prices or Alternate bid with any other Bidder; (b) unless otherwise required by law, the Base Bid, any Unit Prices and any Alternate bid in the bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder prior to the bid opening, directly or indirectly, to any other Bidder who would have any interest in the Base Bid, Unit Prices or Alternate bid; (c) no attempt has been made or will be made by the Bidder to induce any other Person to submit or not to submit a bid for the purpose of restricting competition; and (d) the statements made in this Bid Form are true and correct.
7. The Bidder will execute the form of Owner/Contractor Agreement in the form included with the Contract Documents, if a Contract is awarded on the basis of this bid, and if the Bidder does not execute the Contract Form for any reason, other than as authorized by law, the Bidder and the Bidder's Surety are liable to the Owner.
8. The Bidder certifies that the upon the award of a Contract, the Contractor will ensure that all of the Contractor's employees, while working on the Project site, will not purchase, transfer, use or possess illegal drugs or alcohol or abuse prescription drugs in any way.
9. The Bidder agrees to furnish any information requested by the Design Professional or the Owner's authorized representative to evaluate that the Bidder has submitted the lowest responsible bid and that the bid is responsive to the specifications.
10. The Bidder certifies that it has no unresolved findings for recovery issued by the Auditor of State.
11. The Bidder certifies that it is aware of and in compliance with the requirements of Ohio Revised Code Section 3517.13 regarding campaign contributions.
12. The Bidder further states that it is a duly licensed contractor, for the type of work proposed, in accordance with the local requirements, and that all fees, permits, etc., pursuant to submitting this Bid have been paid in full.

LEGAL NAME OF BIDDER: _____

BIDDER IS (check one): sole proprietor partnership corporation other legal entity

NAME & TITLE OF PERSON LEGALLY AUTHORIZED TO BIND BIDDER TO A CONTRACT:

| | |
|--------------------|--------------------------|
| Name | Title |
| DATE SIGNED: _____ | SIGNATURE: _____ |
| | ADDRESS: _____ |
| | _____ |
| | TELEPHONE: _____ |
| | FAX: _____ |
| | FEDERAL TAX I.D. # _____ |

When the Bidder is a partnership or a joint venture, state name and address of each partner in the partnership or participant in the joint venture below:

| | |
|------|---------|
| | |
| Name | |
| | Address |
| | |
| Name | |
| | Address |
| | |
| Name | |
| | Address |
| | |
| Name | |
| | Address |
| | |
| Name | |
| | Address |

END OF SECTION

CONTRACTOR'S QUALIFICATION STATEMENT

SUBMITTED TO: _____

NAME OF PROJECT: _____

SUBMITTED BY: _____

CONTRACTOR PROJECT CONTACT NAME: _____

ADDRESS: _____

EMAIL: _____

PHONE: _____

PRINCIPAL OFFICE: _____

- Corporation
- Partnership
- Individual
- Joint Venture
- Other

| # | Question | Response |
|-------------------------|---|----------|
| 1 - Organization | | |
| 1.1 | How many years has your organization been in business as a Contractor in the construction industry? | |
| 1.2 | How many years has your organization been in business under its present business name? | |
| 1.2.1 | Under what other or former names has your organization operated? | |
| 1.3 | Is your organization a corporation? If yes, answer #1.3.1 – 1.3.6 | |
| 1.3.1 | Date of incorporation | |
| 1.3.2 | State of incorporation | |

| | | |
|-------|---|--|
| 1.3.3 | President's name | |
| 1.3.4 | Vice President's name(s) | |
| 1.3.5 | Secretary's name | |
| 1.3.6 | Treasurer's name | |
| 1.4 | Is your organization a partnership? If yes, answer #1.4.1 – 1.4.3 | |
| 1.4.1 | Date of organization | |
| 1.4.2 | Type of partnership (if applicable) | |
| 1.4.3 | Name(s) of general partner(s) | |
| 1.5 | Is your organization individually owned? If yes, answer #1.5.1 – 1.5.2 | |
| 1.5.1 | Date of organization | |
| 1.5.2 | Name of owner | |
| 1.6 | If the form of your organization is other than those listed above, describe it and name the principals. | |

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| 2 - Licensing | | |
| 2.1 | List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration or license numbers, if applicable. | |
| 2.2 | List jurisdictions in which your organization's partnership or trade name is filed. | |
| 2.3 | List any suspension or revocations of any professional license of any director, officer, owner, or managerial employees of your organization, to the extent that any work to be performed on this Project is within the field of such licensed profession. | |
| 3 - Financing: After bid opening, within 24 hours of a request made by the Owner or Design Professional, the apparent low Bidder and any other Bidder must submit additional financial information as requested. | | |
| 4 - References | | |
| 4.1 | Trade References | |

| | | |
|-------------------------------------|---|--|
| 4.2 | Bank References | |
| 4.3 | Surety – name of bonding company | |
| 4.4 | Surety – name and address of agent | |
| 5 – Claims and Organization History | | |
| 5.1 | Attach your organization’s record for both resolved and unresolved findings of the Auditor of the State of Ohio for recovery as defined in Section 9.24 of the Ohio Revised Code. If none, state “none”. | |
| 5.2 | Does your organization participate in a drug-free workplace program? | |
| 5.3 | Has your organization ever failed to complete any work or failed to complete any work by the substantial completion date, final completion date, or in a timely manner? If yes, attach details. | |
| 5.4 | <p>Within the last five (5) years has your organization or any of its officers prosecuted any Claims, had any Claims prosecuted against it or them, or been involved in or is currently involved in any mediation or arbitration proceedings or lawsuits related to any construction project, or has any judgments or awards outstanding against it or them? If the answer is yes, please attach the details for each Claim, including the names and telephone numbers of the persons who are parties, the amount of the Claim, the type of Claim and basis for the Claim, and the outcome.</p> <p>Note: As used in this document “Claim” means a Claim initiated under the Contract Documents for a project or relating to the Work for a project, including Claims made against performance bonds secured by the Contractor on other construction projects.</p> | |

| | | |
|-----------------------|--|--|
| 5.5 | Has your organization ever failed to comply with federal, state, and local laws, rules and regulations including but not limited to the Occupational Safety and Health Act, the Ohio Prevailing Wage laws, and Ohio ethics laws? If yes, please attach details and reason(s) for each instance and the outcome including any fines or penalties imposed. | |
| 5.6 | Within the last five years, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract? If the answer is yes, please attach details for each instance, including the names and telephone numbers of the persons who are parties to the contract, and the reason(s) the contract was not completed. | |
| 5.7 | If any of the following members of your organization's management – president, chairman of the board, or any director – operates or has operated another construction company during the last five (5) years, identify the member of management and the name of the construction company. | |
| 5.8 | If your organization is operating under a trade name registration with the Secretary of State for the State of Ohio, identify the entity for which the trade name is registered. If none, state “none.” | |
| 5.9 | If your organization is a division or wholly-owned subsidiary of another entity or has another relationship with another entity, identify the entity of which it is a division or wholly-owned subsidiary or with which it has another relationship and also identify the nature of the relationship. If none, state “not applicable.” | |
| 5.10 | List any projects within the previous five years where a public entity determined that your organization was not a responsible bidder, including the name of the public entity, the reasons given by the public entity, and an explanation thereof. | |
| 6 - Experience | | |
| 6.1 | List the categories of work that your organization normally performs with its own forces | |

| | | |
|-----|--|--|
| 6.2 | State average annual amount of construction work your organization has performed during the last five years | |
| 6.3 | State total amount of work in progress and under contract | |
| 6.4 | Describe the size and experience of your organization's work force and your equipment and facilities, in relation to your organization's ability to complete the Project successfully and on time. | |

6.5 In the chart below, provide the following information for each contract your organization has had during the last 5 years, including current contracts, where the Contract Sum is/was 50% or more of the bid amount for this Project, including add alternates.
Include details regarding timeliness of performance and quality of work.

List the original contract price for each project, the amount of any change orders or cost overruns on each, and the reasons for the change orders or cost overruns, and your organization's record for complying with and meeting completion deadlines on construction projects.

If there are more than 10 of these contracts only provide information on the most recent 10 contracts, including current contracts.

| Project/Scope of Work | Original Contract Sum | Amount of any change orders or cost overruns and reasons | Completion deadlines met? | Owner's Contact & Telephone Number | Engineer's or Architect's Representative Name & Telephone Number |
|-----------------------|-----------------------|--|---------------------------|------------------------------------|--|
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| Project/Scope of Work | Original Contract Sum | Amount of any change orders or cost overruns and reasons | Completion deadlines met? | Owner's Contact & Telephone Number | Engineer's or Architect's Representative Name & Telephone Number |
|-----------------------|-----------------------|--|---------------------------|------------------------------------|--|
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| Project/Scope of Work | Original Contract Sum | Amount of any change orders or cost overruns and reasons | Completion deadlines met? | Owner's Contact & Telephone Number | Engineer's or Architect's Representative Name & Telephone Number |
|-----------------------|-----------------------|--|---------------------------|------------------------------------|--|
| | | | | | |

6.6 In the chart below, provide the following information for each project your organization has had during the last 5 years, which your organization believes is of comparable or greater size and complexity than the Owner's project. If there are more than 5 of these projects, only provide information on the most recent 5 projects, including current projects.

| Project and Scope of Work | Contract Sum | Owner's Contact & Telephone Number | Engineer's or Architect's Representative Name & Telephone Number |
|---------------------------|--------------|------------------------------------|--|
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6.7 In the chart below, list the construction education, training and construction experience for each person who will fill a management role on the Project, including without limitation the Project Executive, Project Engineer, Project Manager, and Project Superintendent. For each person listed, include with the other information, the last three projects on which the person worked and the name and telephone number of the design professional and the Owner. Attach a separate sheet if necessary, identifying the question number.

| Name/Role | Education and Training | Project #1, Owner & A/E Contact, Telephone Number | Project #2, Owner & A/E Contact, Telephone Number | Project #3, Owner & A/E Contact, Telephone Number |
|-----------|------------------------|---|---|---|
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6.8 In the chart below, list construction projects your organization has in progress with an original Contract Sum of more than \$100,000.00, giving the name of project, owner and its telephone number, design professional and its telephone number, contract amount, percent complete and scheduled completion date. Attach a separate sheet if necessary, identifying the question number.

| Project/Scope of Work | Contract Sum | Scheduled Completion Date | % Complete | Owner's Contact & Telephone Number | Engineer's or Architect's Representative Name & Telephone Number |
|-----------------------|--------------|---------------------------|------------|------------------------------------|--|
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Additional Criteria. The Owner, in its discretion, reserves the right to request additional information and documentation relating to the foregoing and related to any of the criteria listed in the Bidding and Contract Documents after the bid opening. The Owner may consider such information and documentation in determining which bidder is the lowest responsible. The Owner, in its discretion, may consider and give such weight to any and all criteria as it deems appropriate.

Certification. The undersigned certifies for the reliance of the Owner that after diligent investigation, to the best of the undersigned's belief, the information provided with this Contractor's Qualification Statement is true, accurate and not misleading.

SIGNATURE _____

Dated at this ____ day of _____, 20__.

Name of Organization: _____

By: _____ [PRINT NAME]

Signature: _____

Title: _____

_____, being duly sworn, deposes and says that the information provided herein is true and sufficiently complete so as not to be misleading. The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

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

Notary Public

My Commission Expires: _____

SEAL

OWNER-CONTRACTOR AGREEMENT

Owner:
Coshocton County District Library
Board of Trustees
655 Main Street
Coshocton, Ohio 43812

Contractor:

Owner’s Representative(s):
Jennifer Austin, Director
Email: jaustin@coshoctonlibrary.com

Contractor’s Representative:

Scope: General Contractor

Project:
HVAC Upgrades and Air Handling
Unit Replacement Project
Main Branch Library
655 Main Street
Coshocton, Ohio 43812

This document is an agreement between the Owner and the Contractor for the Work described in the Contract Documents related to the Scope identified above for the Project defined above and is effective as of _____, 20____ (the “Effective Date”; provided however that if no date is inserted, the Effective Date shall be the date the Agreement is signed by the Owner). The Work for this Project was procured pursuant to the statutory bidding process for libraries per Ohio Revised Code Section 3375.41.

The Owner and the Contractor agree as set forth in the following sections:

- 1. **CONTRACT DOCUMENTS.** The Contract Documents consist of the following documents:
 - A. Public Notice;
 - B. Instructions to Bidders;
 - C. Bid Form and Contractor’s Qualification Statement;
 - D. Owner-Contractor Agreement including exhibits;
 - E. General Conditions of the Contract for Construction (AIA Document A201-2017), as modified (the “General Conditions”);
 - F. Drawings dated September 16, 2022 and Specifications dated September 30, 2022 included in the Project Manual prepared by H.F. Lenz Company;
 - G. Executed Bid Guaranty and Contract Bond;
 - H. Sales & Use Tax/ Construction Contract Exemption Certificate;
 - I. Statement of Claim Form;
 - J. Design Professional’s Certificate of Substantial Completion;
 - K. Contractor’s Affidavit of Payment or Amounts Withheld;
 - L. Contractor Waiver and Release Affidavit;
 - M. Contractor Final Waiver and Release Affidavit;
 - N. Subcontractors/ Suppliers Lien Waiver and Release Affidavit;
 - O. Subcontractors/ Suppliers Final Lien Waiver and Release Affidavit;
 - P. Pre-Bid Substitution Form;
 - Q. Addenda issued;
 - R. Executed Contractor’s Personal Property Tax Affidavit (O.R.C. 5719.042);
 - S. Modifications issued after the execution of the contract, including:

- A written amendment to the Agreement signed by both parties;
- A Change Order; or
- A Construction Change Directive

T. Prevailing Wage Rates

1.1. Notwithstanding anything in the Contract Documents to the contrary, in the event of any inconsistency, the provisions of this Agreement shall control over any other Contract Document, proposal, document, or other attachment. In the event inconsistencies, conflicts, or ambiguities between or among the Contract Documents are discovered after execution of the Agreement, Contractor shall provide the better quality or greater quantity of Work or comply with the more stringent requirements.

1.2. Contractor will use the State of Ohio Subcontract Form for all subcontracted Work, in accordance with ORC 153.503(C) and OAC 153:1-3-02.

Note: Non-Contract Documents. The following are the reports and tests of subsurface conditions at or contiguous to the Site, if any, that the Design Professional has used in preparing the Contract Documents. These are not Contract Documents. Geotechnical data is not a warranty of subsurface conditions and is not to be relied upon as a complete representation of all possible soil conditions. Neither Owner nor its consultants warrant the accuracy of the geotechnical data. It is possible that there may be other reports, and/or tests of subsurface conditions at or contiguous to the Site not prepared by or on behalf of Owner. The Owner makes no representation about such reports and/or tests, assuming they exist. Additional information, if needed by Contractor for geotechnical data or site survey, shall be obtained by the Contractor at no additional cost to Owner. The General Conditions, as modified, contain additional terms related to these reports and tests.

Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings listed below, and except for such reliance on "technical data," Contractor shall not rely upon or make any claim against Owner or Architect with respect to: (1) the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or (2) other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or (3) any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information. For example, all interpolations and extrapolations of data performed by Contractor to estimate locations or quantities of subsurface strata are independent factual assumptions which Owner does not warrant. (None if none are listed.)

Note: Non-Contract Documents. The following are those reports and drawings related to any Hazardous Conditions at the Site, if any. These are not Contract Documents. The General Conditions, as modified, contain additional terms related to these reports and drawings. (None if none are listed.)

2. DESIGN PROFESSIONAL RELATIONSHIP. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Design Professional and the Contractor or any Subcontractor or Material Supplier to the Project. The Design Professional, however, shall be entitled to performance of the obligations of the Contractor intended for its benefit and to enforcement of such obligations, but nothing contained herein shall be deemed to give the Contractor or any third party any claim or right of action against the Design Professional that does not otherwise exist without regard to this Contract. The Contractor and its Subcontractors shall not be deemed to be beneficiaries of any of the acts

or services of the Design Professional that are performed for the sole benefit of the Owner. Except as otherwise set forth herein, the Contractor shall communicate with the Owner through the Design Professional. Contractor shall copy Owner on all communications that may result in a request for an adjustment to the Contract Time or Contract Sum.

2.1. The Design Professional is:

H.F. Lenz Company
1407 Scalp Avenue
Johnston, Pennsylvania 15904

Any references to the "Architect" or the "Engineer" in the Contract Documents are deemed to refer to the Design Professional identified herein.

3. TIME FOR COMPLETION ("CONTRACT TIME") AND PROJECT COORDINATION.

3.1. DATE OF COMMENCEMENT. The date of commencement of the Work shall be the date identified as the "Date of Commencement" in the Notice to Proceed issued by the Owner, or by the Owner through the Design Professional, to the Contractor, or if there is no Notice to Proceed, the Effective Date of this Agreement.

3.2. DATE FOR SUBSTANTIAL COMPLETION. The Project and Work for the Project consists of all labor, materials, equipment, and services necessary for construction of the Project, all in accordance with the Drawings and Specifications prepared by the Design Professional. The Contractor shall achieve Substantial Completion of its Work on the Project, as defined in the General Conditions, by **March 1, 2024** ("Date for Substantial Completion").

3.2.1. DATE FOR FINAL COMPLETION. The Contractor shall achieve Final Completion of its Work on the Project, as defined in the General Conditions, within **30 calendar days** of the Date of Substantial Completion ("Date for Final Completion").

3.2.2. SHUTDOWN DATES. Due to events scheduled by the Owner and/or other Owner considerations, Contractor will not be able to perform Work on the Project on the following dates: ____ (None if none are listed). Contractor's Construction Schedule for performing the Work shall account for Contractor not being able to perform Work on these dates and the contractual dates for Substantial Completion and Final Completion will not be changed due to Contractor not being able to perform Work on these dates. The Contractor will coordinate any system interruptions with the Owner and the Design Professional and all system interruptions are subject to Owner's prior written approval.

3.2.3. UTILITIES AND OPERATIONS. Contractor shall not interrupt utilities to facilities or existing operations without prior written notice and approval by Owner.

3.3. CONSTRUCTION SCHEDULE. The Construction Schedule shall be developed by the Contractor as provided in the Contract Documents.

3.4. LIQUIDATED DAMAGES. If the Contractor does not have its Work on the Project Substantially Complete by the specified Date for Substantial Completion or if the Contractor does not have its Work on the Project Finally Complete by the specified Date for Final Completion, the Contractor shall pay the Owner (and the Owner may set off from sums coming due the Contractor) Liquidated Damages in the per diem amount(s) identified in the chart below:

| Contract Sum | Liquidated Damages Per Day for Failure to Timely Achieve: | |
|------------------------------------|--|------------------|
| | Substantial Completion | Final Completion |
| \$1,000,000.00 or less | \$500 | \$125 |
| \$1,000,000.01 to \$2,000,000.00 | \$700 | \$250 |
| \$2,000,000.01 to \$5,000,000.00 | \$1,000 | \$500 |
| \$5,000,000.01 to \$10,000,000.00 | \$2,000 | \$1,000 |
| \$10,000,000.01 to \$20,000,000.00 | \$4,000 | \$1,250 |
| \$20,000,000.01 to \$50,000,000.00 | \$5,000 | \$1,500 |
| \$50,000,000.01 or more | \$7,000 | \$2,000 |

The Contractor acknowledges that such amounts of Liquidated Damages represent a reasonable estimate of the actual damages for loss of or interference with the intended use of the Project that the Owner would incur if the Contractor's Work is not Substantially Complete by its Date for Substantial Completion or Finally Complete by the required Date for Final Completion, or both. Any waiver of consequential damages shall not preclude the Owner from recovering Liquidated Damages.

3.4.1. Nothing in this Section shall be construed to diminish Owner's indemnity rights pursuant to this Agreement nor shall it preclude the Owner from recovering its actual damages from the Contractor for third-party claims against the Owner or for damages not attributable to delay.

3.5. **INITIAL DECISION MAKER.** The Initial Decision Maker renders initial decisions on Claims in accordance with the claims process set forth in the General Conditions. The Initial Decision Maker shall be the Design Professional, unless a different Initial Decision Maker is identified below:

3.6. Time is of the Essence for the Contractor's performance of the Work.

4. CONTRACT SUM (also called Contract Price). The Contract Sum to be paid by the Owner to the Contractor, as provided herein, for the satisfactory performance and completion of the Work and all of the duties, obligations, and responsibilities of the Contractor under this Agreement and the other Contract Documents is [REDACTED] Dollars (\$ [REDACTED]), subject to adjustment as set forth in the Contract Documents. The Contract Sum includes Allowances, Accepted Alternates, and all federal, state, county, municipal, and other taxes imposed by law, including but not limited to any sales, use, commercial activity, and personal property taxes payable by or levied against the Contractor on account of the Work or the materials incorporated into the Work. The Contractor will pay any such taxes. The Contract Sum includes the following:

4.1. Base Bid Amount: \$ [REDACTED] (Lump Sum Bid);

4.2. [Not Used.]

4.3. [Not Used.]

4.4. [Not Used.]

4.5. If after Substantial Completion of its Work, the Contractor fails to submit its final payment application with all the documents required to be submitted with such application within ninety (90) days after written notice to do so from the Owner and without prejudice to any other rights and remedies the Owner may have available to it, the balance of the Contract Sum shall become the Owner's sole and exclusive property, and the Contractor shall have no further interest in or right to such balance.

5. RETAINAGE. Retainage applicable to the Contract will be withheld in accordance with Ohio Revised Code Sections 153.12, .13, and .14 and the Modified General Conditions.

5.1. **RETAINAGE FOR LABOR.** Payments for labor incorporated into the Work will be at the rate of 92% of the amount set forth in Contractor's payment application and approved by Owner until the Work is 50% complete, unless the parties agree otherwise. When the Work is 50% complete, the payment for labor incorporated into the Work will be at the rate of 100% of the amount set forth in Contractor's payment application and approved by Owner.

5.2. **RETAINAGE FOR MATERIALS AND EQUIPMENT.** Payments for materials and equipment will be at the rate of 92% of the invoice cost of materials and equipment delivered to the Project site or other storage site approved by Owner. The balance of the invoice cost will be payable when the materials or equipment are incorporated into the Work. Incorporated into the Work means such materials and equipment are installed and conform to the requirements of the Contract Documents. When payment is made on account of materials or equipment not yet incorporated into the Project, such materials and equipment will become the property of Owner; provided that if such materials or equipment are stolen, destroyed, or damaged before being fully incorporated into the Project, Contractor shall be required to replace them at its expense.

6. PREVAILING WAGE RATES. The Contractor and its subcontractors, regardless of tier, shall strictly comply with their obligation to pay their employees working on the Project site at the applicable prevailing wage rates for the type of work, including any changes thereto, pursuant to Ohio Revised Code Chapter 4115. Contractor shall submit a Certified Payroll Report for payment of prevailing wages with each Application for Payment as well as a final certified payroll report and the required Affidavit of Compliance with its final Application for Payment.

7. GENERAL.

7.1. **MODIFICATION.** No modification or waiver of any of the terms of this Agreement or of any other Contract Documents shall be effective against a party unless set forth in writing and signed by or on behalf of that party. In the case of the Owner, the person executing the modification or waiver must be duly authorized by action of the Owner's governing body. Under no circumstances will forbearance, including the failure or repeated failure to insist upon compliance with the terms of the Contract Documents, constitute the waiver or modification of any such terms. The parties acknowledge and agree that it may not rely upon common law waiver or estoppel principles to establish an alleged waiver or modification of this Agreement or the Contract Documents and rather that this Agreement and the Contract Documents can only be waived or modified pursuant to this paragraph. The parties acknowledge that no person has authority to modify this Agreement or the other Contract Documents or to waive any of its or their terms, except as expressly provided in this Paragraph.

7.2. **ASSIGNMENT.** Contractor may not assign this Agreement without the written consent of Owner, which Owner may withhold in its sole discretion.

7.3. **THIRD PARTIES.** Nothing contained in the Contract Documents shall create a contractual relationship with or a cause of action in favor of a third party against either Owner or Contractor. However, it is understood that the Owner is an intended third-party beneficiary of Contractor's agreements with its Suppliers, and Subcontractors, and Suppliers' and Subcontractors' agreements with their Sub-Suppliers, and Sub-Subcontractors. Contractor shall incorporate the obligations of this Agreement into its respective agreements and subcontracts.

7.4. **LAW AND JURISDICTION.** All questions regarding the validity, intention, or meaning of this Agreement or any modifications of it relating to the rights and obligations of the parties shall be construed and resolved under the laws of the State of Ohio. Any suit, which may be brought to enforce any provision of this Agreement or any remedy with respect hereto, shall be brought in the Common Pleas Court for the county in which the Project is located and each party hereby expressly consents to the exclusive jurisdiction of such court. Each party waives its right to remove any such suit to federal court.

7.5. STATUTE OF LIMITATIONS. Regardless of any provision to the contrary, the statute of limitations with respect to defective or non-conforming Work shall not commence until Substantial Completion or until the discovery of the defective or non-conforming Work by the Owner, whichever is later.

7.6. CONSTRUCTION. The parties acknowledge that each party has reviewed this Agreement and the other Contract Documents and has voluntarily entered into this Agreement. Accordingly, the normal rule of construction to the effect that any ambiguities are to be resolved against the drafting party shall not be employed in the interpretation of this Agreement, the other Contract Documents, or any amendments or exhibits to it or them.

7.7. APPROVALS. Except as expressly provided herein, the approvals and determinations of Owner will be subject to the sole discretion of Owner and will be valid and binding on the Contractor, provided only that they be made in good faith, i.e., honestly. If Contractor challenges any such approval or determination, Contractor bears the burden of proving by clear and convincing evidence that it was not made in good faith.

7.8. PARTIAL INVALIDITY. If any term or provision of this Agreement is found to be illegal, unenforceable, or in violation of any laws, statutes, ordinances, or regulations of any public authority having jurisdiction, then, notwithstanding such term or provision, this Agreement will remain in full force and effect and such term will be deemed stricken; provided this Agreement will be interpreted, when possible, so as to reflect the intentions of the parties as indicated by any such stricken term or provision.

7.9. COMPLIANCE WITH LAWS AND REGULATIONS. The Contractor, at its expense, will comply with all applicable federal, state, and local laws, rules, and regulations applicable to the Work, including but not limited to Chapter 4115 of the Ohio Revised Code and Sections 153.59 and 153.60 of the Ohio Revised Code, which prohibit discrimination in the hiring and treatment of employees, with respect to which the Contractor agrees to comply and to require its subcontractors to comply.

7.10. PROJECT SAFETY. Contractor must follow all applicable safety and health regulations during the progress of the Project and monitor all of its employees and its subcontractors for compliance with such safety and health regulations. In undertaking the responsibilities set forth in this section, Contractor does not assume any duty of responsibility to the employees of any Subcontractor or supplier, regardless of tier. Owner assumes no responsibility for the development, review, or implementation of any project safety plan or for Project safety and has no authority to direct the means and methods of Contractor.

7.11. EQUAL OPPORTUNITY. Contractor will not, and it will ensure that its Subcontractors, regardless of tier, do not, discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin. Such action includes but is not limited to the following: employment, upgrading, demotion, transfer, recruitment or recruiting advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of nondiscrimination. Contractor is responsible to ensure that each of its Subcontractors, regardless of tier, states in all solicitations or advertisements for employees placed by them or on their behalf that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, or national origin.

7.12. NO FINDINGS FOR RECOVERY. The Contractor represents that the Contractor is not subject to a finding for recovery under Section 9.24, Ohio Revised Code, or that the Contractor has taken the appropriate remedial steps required under Section 9.24, Ohio Revised Code, or otherwise qualifies under this section. If this representation and warranty is found to be false, the Contract is void, and Contractor will immediately repay Owner any funds paid to Contractor under this Contract.

7.13. NON-DISCRIMINATION. Contractor agrees:

- .1 That in the hiring of employees for the performance of Work under this Agreement or in any subcontract, neither the Contractor, subcontractor, or any person acting on

behalf of either of them, shall by reason of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color discriminate against any citizen of the state in the employment of labor or workers who are qualified and available to perform the Work to which the employment relates.

2. That neither the Contractor, subcontractor, nor any person acting on behalf of either of them shall, in any manner, discriminate against or intimidate any employee hired for the performance of Work under this Agreement on account of race, creed, sex, disability as defined in Section 4112.01 of the Ohio Revised Code, or color.
3. That there shall be deducted from the amount payable to the Contractor by the Owner under this Agreement a forfeiture of twenty-five dollars (\$25.00) as required by Ohio Revised Code Section 153.60 for each person who is discriminated against or intimidated in violation of this Agreement.
4. That this Agreement may be canceled or terminated by the Owner and all money to become due hereunder may be forfeited for a second or subsequent violation of the terms of this section of this Agreement.

7.14. ETHICS. By signing and entering into this agreement with the Owner, the Contractor represents that it is familiar with all applicable ethics law requirements, including without limitation Sections 102.04 and 3517.13 of the Ohio Revised Code, and certifies that it is in compliance with such requirements. The Contractor understands that failure to comply with the ethics laws is, in itself, grounds for termination of this contract and may result in the loss of other contracts with the Owner.

7.15. JOB MEETINGS. The Contractor or one of its representatives with authority to bind the Contractor will attend all job meetings. The Owner anticipates that job meetings will be scheduled on a weekly basis during construction or as needed. The Contractor will ensure that its Subcontractors also hold regular job meetings at which safety issues and job matters are discussed as these relate to the Work being performed. Job meetings include, but are not limited to, pre-construction meetings, weekly job meetings, weekly safety tool box meetings, and monthly safety meetings.

7.16. PROPERTY TAX AFFIDAVIT. The Contractor's affidavit given under Section 5719.024, Ohio Revised Code, is incorporated herein.

7.17. WARRANTIES. Notwithstanding anything to the contrary in the Contract Documents, including the Project Manual, Drawings, and Specifications, no warranties by Contractor shall be limited to any time shorter than the statute of limitations for written contracts in Ohio.

7.18. ENTIRE AGREEMENT. This Agreement and the other Contract Documents constitute the entire agreement among the parties with respect to their subject matter and will supersede all prior and contemporaneous, oral or written, agreements, negotiations, communications, representations, and understandings with respect to such subject matter, and no person is justified in relying on such agreements, negotiations, communications, representations, or understandings.

7.19. EXHIBITS. Exhibits to this Agreement include:

Exhibit A: Contract Bond

Exhibit B: Sales and Use Tax Construction Contract Exemption Certificate

Exhibit C: Statement of Claim Form

Exhibit D: Design Professional's Certificate of Substantial Completion

Exhibit E: Contractor's Affidavit of Payment or Amounts Withheld

Exhibit F: Contractor Waiver and Release Affidavit

Exhibit G: Subcontractors/Suppliers Waiver and Release Affidavit

Exhibit H: Contractor Final Lien Waiver and Release Affidavit

Exhibit I: Subcontractor/Suppliers Final Lien Waiver and Release Affidavit

Exhibit J: Prevailing Wage Rates

However, in the event of any inconsistency, the provisions of this Agreement control over any proposal, document, or other attachment.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed by their properly authorized representatives and agree that this Agreement is effective as of the date first set forth above.

Owner: **Coshocton County District Library** Contractor:
Board of Trustees

By: _____

By: _____

Name: _____

Name: _____

Title: _____

Title: _____

Date: _____

Date: _____

CERTIFICATE

(O.R.C. Section 5705.41)

The undersigned, fiscal officer of the Owner, certifies that the moneys required to pay that part of the Contract Sum coming due during the current fiscal year, under the Agreement to which this Certificate is attached have been lawfully appropriated for such purpose and are in the appropriate account of the Owner, or in the process of collection to the credit of the appropriate account or fund, free from any previous encumbrances. Moneys due in excess of the Contract Sum shall require an additional and separate Fiscal Officer's Certificate.

DATED: _____

Fiscal Officer



AIA® Document A201® – 2017

General Conditions of the Contract for Construction

THIS DOCUMENT HAS BEEN MODIFIED FROM ITS ORIGINAL FORM.

for the following PROJECT:

(Name and location or address)

HVAC Upgrades and Air Handling Unit Replacement Project
655 Main Street
Coshocton, Ohio 43812

THE OWNER:

(Name, legal status and address)

Coshocton County District Library Board of Trustees
655 Main Street
Coshocton, Ohio 43812

THE ARCHITECT: DESIGN PROFESSIONAL:

(Name, legal status and address)

H.F. Lenz Company
1407 Scalp Avenue
Johnston, Pennsylvania 15904

The Design Professional may also be referred to as the “Architect” in the Contract Documents.

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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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions The definitions in this Section 1.1 shall apply throughout the Contract Documents.

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of 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. the Contract Documents identified in the

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Owner-Contractor Agreement (“Agreement”). 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 do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor’s bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 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, paperwork, reports, documentation, other requirements, 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 Architect unless another person is identified in writing.

§ 1.1.9 Finally Resolved

the Agreement to render initial decisions on Claims Finally Resolved means that the Initial Decision Maker has made a decision on a Claim under Section 15.2.6.1 of the General Conditions and that any litigation regarding the Claim has been concluded.

§ 1.1.10 Claim

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~~in accordance~~ Claim is defined in Section 15.1.1 of these General Conditions.

§ 1.1.11 Statement of Claim Form

Statement of Claim Form means the Statement of Claim Form included with the Project Manual.

§ 1.1.12 Separate Contractor

~~Section 15.2.~~ Separate Contractor is defined in Section 6.1.1 of these General Conditions.

~~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.~~ **§ 1.1.13 Standard of Care** The Contractor shall perform its services consistent with the professional skill and care ordinarily provided by experienced contractors and working in the same or similar locality under the same or similar circumstances. Contractor shall perform its services as expeditiously as is consistent with such professional skill and care and the orderly progress of the Project.

§ 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. ~~Contractor whether or not expressly shown or described.~~ The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; ~~all and~~ 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.

§ 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.

§ 1.2.1.2 In the event of inconsistencies within or between the Contract Documents, the Contractor must provide the better quality or greater quantity of Work and must comply with the stricter requirements.

§ 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.

§ 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.

§ 1.3 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 ~~The Architect and the Architect's consultants shall be deemed the authors and owners of their Ownership of the respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and shall be as provided in the Owner-Architect Agreement. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal 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 the Architect's or Architect's consultants' reserved rights.~~ ownership of the Instruments of Service.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and material or equipment 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 material or equipment 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.~~ Notices, Requests, or demands by either party shall be in writing, unless otherwise expressly authorized, and shall be personally served; forwarded by expedited messenger service; sent by facsimile transmission; sent by electronic

§ 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.~~ mail with delivery confirmation; or be given by registered or certified mail, return receipt requested, postage prepaid, and address by given written notice hereunder. All notices, requests, and demands shall be deemed received upon receipt in the case of personal delivery or delivery by expedited messenger service, including leaving the notice at the address provided herein during normal business hours; upon the expiration of forty-eight (48) hours from the time of deposit in the United States mail; or, in the case of a notice given by electronic mail or facsimile transmission, upon the expiration of 24 hours after the transmission is sent.

§ 1.7 Digital Data Use and Transmission

~~The parties shall agree upon protocols governing the transmission and use of~~ If the parties intend to transmit 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. ~~form, they shall endeavor to establish necessary protocols governing such transmissions, unless already provided in the Agreement or the Contract Documents.~~

§ 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, E203™-2013, Building Information Modeling and Digital Data Exhibit,~~ and the requisite AIA Document ~~G202™ 2013, 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.

§ 1.9 Preconstruction Conference

Before any Work at the Site is started, a conference attended by the Owner, Contractor, Architect, and others as appropriate may be held to establish a working understanding among the parties as to the Work and to discuss the Submittal Schedule, Construction Schedule, and Schedule of Values, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

§ 1.10 Initial Acceptance of Schedules

At least 10 days before submission of the first Application for Payment a conference attended by a Contractor, Architect, and others as appropriate will be held to review for acceptability to the Architect the schedules submitted in accordance with the Contract Documents, including a Submittal Schedule, Construction Schedule, and Schedule of Values. The Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to the Contractor until acceptable schedules are submitted to the Architect and Owner.

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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. may designate in writing a representative. The Owner's representative shall have such authority only as is expressly authorized by the Owner's legislative body and as is permitted under the law of the State of Ohio. The Contractor is responsible for determining the limits of that authority.

§ 2.1.2 The Owner shall furnish to the Contractor, may prepare a Notice of Commencement for the Project, as required by the Ohio Revised Code and shall furnish to the Contractor a copy of the Notice of Commencement for the Project, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein. request.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to 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. The Owner shall complete the certificate(s) of available resources required by the Ohio Revised Code as evidence of available funds to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 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. [Not Used.]

§ 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. [Not Used.]

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 to the Contractor 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. All security related information shall be automatically deemed confidential.

§ 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. initial plan approvals, easements, or assessments.

§ 2.3.2 The Owner ~~shall~~may retain an architect lawfully licensed to practice ~~architecture, architecture and/or engineering,~~ architecture and/or engineering, or an entity lawfully practicing ~~architecture, architecture and/or engineering,~~ 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.

§ 2.3.3 If the employment of the Architect terminates, the Owner ~~shall~~may 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~~To the extent necessary for the Work and as requested by the Contractor, the Owner may furnish 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 but shall exercise proper precautions relating to the safe performance of the Work. The Contractor may rely upon the general accuracy of the “technical data” contained in such reports and drawings, and except for such reliance on “technical data,” the Contractor shall not rely upon or make any claim against the Owner or Architect with respect to: (1) the completeness of such reports and drawings for the Contractor’s purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by the Contractor, and safety precautions and programs incident thereto; or (2) other data, interpretation, opinions, and information contained in such reports or shown or indicated in such drawings; or (3) any Contractor interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions, or information. For example, all interpolations and extrapolations of data performed by the Contractor to estimate locations or quantities of subsurface strata are independent factual assumptions which the Owner does not warrant.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner’s control and relevant to the Contractor’s performance of the Work with reasonable promptness after receiving the Contractor’s written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 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, except to the extent required by Section 6.1.3.

§ 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~~ two business days 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 or thereafter proceed~~ without interruption to correct such default or neglect within fifteen days of such notice, the Owner, without prejudice to its other remedies, may correct such deficiencies. If such default or neglect results in a threat to the safety of any person or property, the Contractor shall immediately commence to correct such default or neglect upon receipt of written or oral notice thereof. In all such cases of default or neglect, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the costs arising out of or related to the investigation and correction of such deficiencies, including Owner’s attorneys’ and consultants’ fees and expenses and other expenses and compensation for the Architect’s additional services made necessary by such default, neglect, or failure. If current and future payments due the Contractor 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.

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~~ jurisdiction(s) 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~~ Documents and shall comply with all rules, regulations, and policies of the Owner and all applicable federal, State, and local codes, statutes, ordinances, and regulations in the performance of the Work on the Project.

§ 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 Agreement~~ by the Contractor is a representation that the Contractor has visited the site, ~~become generally carefully and diligently investigated the entire site and surrounding area, including existing buildings, if any, location, condition, and layout of the site and utility locations, become thoroughly familiar with local conditions under which the Work is to be performed, including the generally occurring climatic conditions and carefully correlated personal observations and other information with requirements of the Contract Documents.~~

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the ~~Work~~, Work and in addition to the reviews required by the Instructions to Bidders and by these General Conditions, 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,~~ 2.3.4. In addition, prior to performing each portion of its Work, the Contractor 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. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the it, including the Work of the other Contractors. The obligations of this Section 3.2.2 are for the purposes of facilitating construction by the Contractor, for determining that the Work is constructible, for determining if the work of the Contractor is coordinated in the Contract Documents with the Work of any other Contractors, and for verifying that field conditions, including the Work of other Contractors, are consistent with the information in the Contract Documents and ready for the Work. The Contractor shall promptly report to the Architect any errors, inconsistencies or omissions and the Owner any inconsistencies, errors, or omissions in the sizing, load bearing capacity, or other design information in the Contract Documents discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor’s review is made in the Contractor’s capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 ~~The Contractor is not required to ascertain that the Contract Documents are in accordance. Additionally, prior to performing each portion of the Work, the Contractor shall have a competent person review the Contract Documents for compliance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect and to the extent that Contractor discovers any conflicts, the Contractor shall immediately report to the Architect and Owner 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~~ make 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

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Section 15.1.7, if applicable, as would have been avoided if the Contractor had performed such obligations. ~~If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.~~

§ 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~~ attention and consistent with the skill of a competent contractor. 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 ~~Contract~~ Contract Documents. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect, and shall not proceed with that portion of the Work without further written instructions from the Architect. The Contractor shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures. ~~The Contractor shall immediately upon entering the Project for the purpose of beginning work, locate all general reference points and take such action as necessary to prevent their destruction. The Contractor shall lay out his own work and be responsible for all lines, elevations, and measurements of the building, demolition work, utilities, and any other work to be executed by him under the contract. The Contractor shall verify grades, lines, levels, and dimensions indicated on the drawings and shall notify the Architect of errors or inconsistencies before commencing work. The Contractor shall establish and maintain a permanent benchmark, batter boards, level, and grades and shall lay out the exact location of all walls, partitions, openings, etc. The Contractor shall employ experienced and competent engineers and exercise proper precautions to verify the figures shown on the drawings for laying out work, and will be held responsible for any error resulting from his failure to exercise such precautions.~~

§ 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.

§ 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.

§ 3.3.4 The Contractor shall maintain readily accessible to the Architect and Owner at the Project site, the following documents all of which shall be "public records" within the meaning of the Ohio Public Records Act:

- .1 A set of Drawings and Specifications, as approved by the appropriate Authority Having Jurisdiction.
- .2 Unless otherwise specifically provided in the Contract Documents, a neat and legible set of As-Built Drawings and Project Manuals on which:
 - .1 The Contractor shall keep an accurate record of all approved changes made to the Drawings to show actual installation where installation varies from Work as originally shown, including the exact location and depth of underground utility lines. Any such changes shall be noted by Change Order Number and drawn neatly in a contrasting color;
 - .2 The Contractor shall also keep record of all changes to the Specifications. When Shop Drawings are used, the Contractor shall cross-reference the corresponding sheet numbers on the As-Built Drawings and sections of the Specification;
 - .3 A daily log at the Project site in which it has recorded Project-related information, including, but not limited to, the weather, number of workers on site for each Contractor, identification of equipment, Work accomplished, problems encountered, and other similar relevant Project data;

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- .4 As applicable to its Work, all Bulletins, Addenda, approved Shop Drawings, Product Data, Samples, manufacturers' installation, operating and/or maintenance instructions or requirements, certificates, warranties, Change Orders, Change Directives, other Modifications, and complete back-up data for all Change Orders, Change Directives, and other Modifications;
- .5 All the Contractor's communications, including but not limited to letters, memoranda, e-mail, invoices, and bills of lading, arising out of or related to the Project with the Architect, Owner, and/or its subcontractors, materialmen, and/or employees; and
- .6 The payroll reports for its employees and the employees of its Subcontractors working on the Project.
- .3 Claims for the Contractor's failure to comply with the Ohio Public Records Act, if applicable, shall be claims under Section 3.18.1.
- .4 Any other forms required under the terms of the Agreement.

§ 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, which the Owner may withhold in its sole discretion, 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. only assign competent supervisors and workers to the Project, each of whom is fully qualified to perform the tasks assigned. If the Owner or Architect deems any employee of the Contractor or a Subcontractor unsatisfactory, the Contractor will transfer or require its Subcontractor to transfer such employee from the Project immediately and replace or require the prompt replacement of such employee with a competent employee. The Owner, however, shall be under no obligation to do so.

§ 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. 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. defects. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. 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. If the Contractor breaches any of its obligations under Section 3.5.1, the Contractor will pay the Owner for its damages and expenses, including but not limited to attorneys' and consultants' fees and expenses, arising out of or related to such breach.

§ 3.5.3 Except to the extent that the Contractor has notified the Architect in writing at least ten (10) days prior to the bid opening of specific problems with specified equipment or materials, the Contractor warrants that any equipment or materials selected by it from among the equipment or materials specified will be fit for its intended purposes,

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compatible with the design intent, and, if the other contractors construct their work in accordance with the Contract Documents, constructible all without additional cost to the Owner. Such notice shall be conspicuously labeled at the top of the first page in not less than twelve point type as follows: **“NOTICE OF PROBLEMS WITH SPECIFIED EQUIPMENT OR MATERIALS.”**

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use-use, commercial activity, and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect. The Contractor acknowledges that the Owner is a political subdivision of the State of Ohio or tax exempt organization and is exempt from state sales, and use taxes. Upon written request, the Owner will provide the Contractor with any applicable certificates of exemption.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 ~~Unless otherwise provided in the Contract Documents,~~ provided by the Owner or Architect, 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.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders and all other requirements of public authorities applicable to performance of the Work.

§ 3.7.3 ~~If the Contractor~~ In addition to its other obligations under the Contract Documents, if the Contractor or any of its Subcontractors or Sub-subcontractors performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders and all other requirements of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

~~If~~ Subject to Section 2.3.4 of these General Conditions, and except as provided herein, if the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and ~~Contractor,~~ Contractor in writing, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 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. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. 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. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

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

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§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

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

§ 3.9 Superintendent & Construction Supervision

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. 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 furnish in writing to the Owner and the Architect of the name and qualifications of a proposed superintendent.~~ superintendent in writing. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating ~~(1) whether the Owner or the Architect (+) has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time for review.~~ Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 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.~~ replace the assigned Superintendent without the Owner's consent, except with another Superintendent who is satisfactory to the Owner. If the Contractor proposes to change the Superintendent, the Contractor must submit to the Architect a written request for the change, including the justification for the change, the name and qualifications for the proposed replacement, and the time frame within which the change is proposed to take place. The Contractor shall provide promptly any related additional information the Architect or Owner requests.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, ~~promptly 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 within five (5) days of the date of any request from the Architect or the Owner to submit scheduling information, shall submit the scheduling information for its Work to the Architect and to the Owner in such form and in such detail as requested. The Contractor shall prepare the Construction Schedule within ten (10) days after the date of the Effective Date. The Construction Schedule shall include and be consistent with any applicable Milestone Dates in the Contract Documents or otherwise provided by the Owner. The Contractor shall prepare all Construction Schedules in CPM format unless provided otherwise in the Contract Documents or otherwise agreed in writing by the Owner. Each major category of work shall be shown separately in the Construction Schedule with all the significant activities involved, showing durations of time, manpower requirements, and restraints. The Construction Schedule is for the purpose of coordinating the timing, phasing, and sequence of the Work of the Contractor and shall not change or modify the Date for Substantial Completion. The Date for Substantial Completion shall only be changed or modified by Change Order, other Modification, or a Claim that is Finally Resolved, regardless of the dates in the Construction Schedule.~~

~~each portion.~~ **.1** The Contractor shall update the Construction Schedule each month;

~~of the Work.~~ **.2** The Construction Schedule shall be manpower loaded and shall include a schedule of the submission of Shop Drawings, Product Data, and Samples;

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~~The schedule shall provide for the orderly progression of the Work.~~ **3** The Contractor shall, on a weekly basis, prepare and submit to the Architect and Owner a written report describing the activities begun or finished during the preceding week, Work in progress, expected completion of the Work, a look-ahead projection of all activities to be started or finished in the upcoming two (2) weeks, including without limitation the Contractor's workforce crew size and total resource hours associated with such Work and any other information requested;

~~to completion and shall not exceed time limits current under the Contract Documents.~~ **4** The float in the Construction Schedule and any updates to it shall belong to the Owner. Float shall mean the amount of time by which activities may be delayed without affecting the Contract Date for Substantial Completion; and

~~The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.~~

5 The Contractor's obligation to submit requested scheduling information is a material term of its Contract. If the Contractor fails to submit requested scheduling information in writing within five (5) days of a request for such information from the Architect or Owner, the Contractor shall pay and the Owner may withhold from the Contractor Liquidated Damages at the rate of Fifty Dollars (\$50.00) a day for each calendar day thereafter that the Contractor fails to submit the requested information.

§ 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 prepare and submit the submittal schedule(s) 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. Construction Schedule submitted to the Owner and Architect, provided that the Contractor shall comply with any orders under Section 3.10.4. However, preparation of such schedule shall not constitute a waiver of the Owner's rights under the Contract to have the Work completed by the contractual dates of Substantial and Final Completion.

.1 Notice of Delays. The Contractor shall give the Owner and the Architect verbal notice of any delay affecting the Work within two (2) business days of the commencement of the delay. In addition, the Contractor shall give the Owner and Architect written notice of the delay within ten (10) business days of the commencement of the delay with specific recommendations about how to minimize the effect of the delay. The written notice of the delay shall conspicuously state at the top of the first page of the notice in twelve point type or larger that it is a "NOTICE OF DELAY." A notice of delay shall not constitute the submission of a Claim. The Contractor acknowledges and agrees that these notice provisions are material terms of the Contract Documents and give the Owner the opportunity to take action to minimize the cost and/or effect of delays.

§ 3.10.4 If the Architect or the Owner determines that the performance of the Work has not progressed so that it is likely that the Contractor will not Substantially Complete its Work by its Date for Substantial Completion, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the Work, including, without limitation: (i) working additional shifts or overtime; (ii) supplying additional manpower, equipment, and facilities; and (iii) other similar measures (collectively referred to as "Corrective Measures"). If the Owner orders the Contractor to take such corrective measures, the Contractor shall take and continue such Corrective Measures until the Owner is satisfied that the Contractor is likely to Substantially Complete its Work by its Date for Substantial Completion.

.1 The Contractor shall not be entitled to adjustment in the Contract Sum in connection with the Corrective Measures required by the Owner pursuant to this Section 3.10.4, unless the Contractor is able to establish that it is entitled to additional compensation under the terms of the Contract Documents.

§ 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.~~ maintain at the Project site for the Owner and the Architect the documents required by Section 3.3.4. These shall be in electronic form or paper copy, available to the Architect and Owner, and shall be delivered to the Architect in the form requested by the Owner for submittal to the Owner upon completion of the Work as a record of the Work as constructed, or earlier when required by the Contract Documents.

§ 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. Shop Drawings shall also include fabrication, erection and setting Drawings, scheduled Drawings, manufacturer's scale Drawings, wiring and control diagrams, cuts or entire catalogs, pamphlets, descriptive literature, performance, and technical data.

§ 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.

1. If the Shop Drawings or other submittals show variations from the requirements of the Contract Documents, the Contractor shall specify such variations in the Contractor's letter of submittal to the Architect accompanying the submittal. Variations must be approved by Change Order.
2. If the Contractor's Shop Drawings or its submittals do not contain sufficient information, and the Architect must perform more than two reviews with respect to any submittal, the Contractor shall pay the additional costs and expenses incurred by the Owner as a result of such additional reviews by the Architect, and the Owner may withhold from sums due or coming due the Contractor amounts to cover such additional costs and expenses.

§ 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.

§ 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.

§ 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

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Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect in writing 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 written 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 architect~~ 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,~~ a properly licensed architect who shall comply with reasonable requirements of the Owner regarding qualifications and insurance and 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~~ adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by such ~~design professionals,~~ architects, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. 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. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.12.10.2 If [Not Used.]

§ 3.12.11 Instructions. Unless otherwise expressly provided in the Contract Documents, the Contractor shall provide typed or printed instructions covering the operation and maintenance of each item of equipment furnished in a notebook submitted to the Architect for review and transmittal to the Owner. The instructions, as applicable, shall include, but may not be limited to, the following:

- .1 Any schematic piping and wiring diagrams;
- .2 Any valve charts and schedules;
- .3 Any lubrication charts and schedules;
- .4 Guides for troubleshooting;
- .5 Pertinent diagrams and maintenance instructions for all equipment;
- .6 Manufacturer's parts list;
- .7 Operating and maintenance instructions for all equipment;
- .8 Manufacturer's data on all equipment;
- .9 Any testing procedures for operating tests; and
- the Contract Documents require. 10 Other instructions and materials as required by the Contract Documents.

The Contractor shall provide two (2) copies of the above instruction books on or before the Substantial Completion of its Work. The books shall describe the information to be covered clearly and in detail and shall be in form and content satisfactory to the Architect and the Owner.

the Contractor's design professional to certify that the **§ 3.12.12 Testing Following Final Completion.** The Contractor will participate in training sessions for the Owner's maintenance personnel. During the first twelve (12) months following Final Completion of each part of the Project, the Contractor (without additional compensation) will participate in tests scheduled by the Owner, which test the following building systems to the extent applicable to the Contractor's Work; air conditioning system (which shall be conducted during the first full summer following the completion of the Project or at such earlier time as scheduled by the Owner), heating system (which shall be conducted during the first full winter following the completion of the Project or at such earlier time as scheduled by the Owner), and such other systems, including the electrical system, plumbing system, fire protection system, and communications systems, as reasonably requested by the Owner. The Owner will be advised when the testing will be conducted and may observe the testing. It is intended that the testing be a comprehensive series of operation tests designed to determine whether the systems are fully operational in accordance with the requirements of the Contract Documents. If it appears that any of the systems, including equipment and software, do not conform to the requirements of the Contract Documents, the Contractor will remedy the defective and/or non-conforming work as provided in Section 12.2.2.1 of these General Conditions.

§ 3.12.13 Manufacturer's Instructions or Requirements. Without waiving, modifying, or relieving the Contractor from its other obligations under the Contract Documents, including its warranties and any performance specifications, the Contractor shall furnish and install its Work in accordance with any applicable manufacturer's instructions and requirements. Prior to installation, the Contractor shall review carefully the manufacturer's instructions or requirements, and if there is a conflict between such instructions or requirements and the Drawings and/or Specifications, the Contractor shall request clarification from the Architect prior to commencing the Work.

§ 3.12.14 The Contractor shall furnish for each submission of Shop Drawings, one (1) transparency reproduction and sufficient number of prints so the Architect can retain four (4) copies. Where the nature of the material being submitted is such that letter size sheets are a convenient method of presentation, such sheets shall be assembled in the form of booklets with covers showing the name of the job, the names of the Contractor and subcontractor or vendor, the location on the job and a list of the sheets contained. Such booklets need not be in the form of transparencies. Do not submit complete catalogues with items checked for use as shop drawings.

has been performed in accordance with **§ 3.12.15** After review of the submittal, the Architect will return the transparency to the Contractor marked "approved" or "not approved" and shall furnish promptly one copy in either case to the Owner for information and reference purposes on the job. If marked "not approved," the Contractor shall resubmit showing corrections made. After the transparency has been stamped "approved," the Contractor shall distribute all necessary prints to trades involved. No Shop Drawings shall be used if not stamped "approved" by the Architect. All work shall be done in accordance with approved Shop Drawings.

the design criteria, the Contractor shall furnish such certifications to the Architect **§ 3.12.16** Schedules, diagrams, cuts, catalogues, data, etc., as mentioned in this Section 3.12, shall be furnished in sufficient numbers so the Architect can retain four (4) copies and the Contractor will have the necessary number for its distribution. One copy of each of these shall be furnished to the Owner by the Architect for reference on the job and for his permanent records.

§ 3.12.17 All Contractors furnishing material or equipment where shop or setting drawings are required shall obtain measurements and observe conditions at the job and indicate on their drawings that such dimensions have been field measured. The Contractor shall affix its stamp of approval on the drawings as evidence they have been checked before submitting them to the Architect for approval. Where information from one Contractor is required by another before drawings can be made, that information shall be given in sufficient time to cause no delay on the part of either party.

§ 3.12.18 The Contractor shall maintain a separate complete clean set of all shop drawings, data, and correspondence pertinent to maintenance requirement. This complete file shall be submitted to the Owner upon Substantial Completion. Drawings shall contain all changes made during construction.

§ 3.12.19 The Contractor shall keep a complete record of all drawings including dates of issuance, receipt, and approval. A second set shall be maintained at the Project job site.

~~in the form specified by the Architect.~~ **§ 3.12.20** When the Contractor requests a change in any item which will involve a change in related items or supports, the Contractor requesting the change shall be responsible for, and pay all costs in connection with such changes. Changes shall be recorded on shop drawings.

§ 3.13 Use of Site

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

§ 3.13.1.1 Damage to road, features, or the grounds, resulting from hauling, storage of materials, or other activities connected with the Work, will be repaired by the Contractor at its expense to the satisfaction of the Architect.

§ 3.13.2 Signage. The Contractor and any entity for whom the Contractor is responsible shall not erect any sign on the Project site without the prior written consent of the Owner, which may be withheld in the sole discretion of the Owner.

§ 3.13.3 Restricted Activities. Unless expressly permitted by the Contract Documents or by the Owner in writing, the Contractor shall not interfere with the Owner's ongoing operations, shall not permit any of its employees or its Subcontractor's or materialmen's employees to use any existing facilities on the Project site, including, without limitation, lavatories, toilets, entrances, and parking areas, and shall not permit its employees or its Subcontractor's or materialmen's employees to bring any tobacco products, alcoholic beverages, controlled substances, or firearms onto the Project site or any other property owned or controlled by the Owner. Additionally, the Contractor shall not permit its employees or its Subcontractor's or materialmen's employees to use any radios, tape, or compact disc players, or sound amplification equipment at or near the Project site.

§ 3.13.4 The Contractor shall conspicuously post notice of the prohibitions listed in the preceding subparagraphs at the Project site in the same locations as OSHA notices are required to be posted, and shall verbally inform all of the Contractor's employees and the employees of the Contractor's Subcontractors and materialmen, regardless of tier, of such
§-prohibitions.

§ 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.

§ 3.14.3 Patching resulting from operations of any Contractor shall be performed by workers skilled in the trade being patched, and paid for by the Contractor causing such patching.

§ 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. At weekly intervals and as directed by the Owner, the Contractor shall clean up the job. The Contractor shall remove all discarded materials, rubbish, and debris from the premises, taking care to avoid scattering debris along the path of travel. The Contractor shall have a dumpster on the site so as to maintain clean and safe conditions throughout the duration of the Project.

§ 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. The Architect's determination of the costs to be charged to the Contractor shall be final and binding.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located. The Contractor is responsible to provide proper facilities for such access and observation and to provide access to the Work in preparation and progress for special inspections required by the building department or authority having jurisdiction.

§ 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 such 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 the Contractor has reason to believe that the required design, process, or product is an infringement of a copyright or patent is discovered by, or made known to, the Contractor, patent, 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~~ indemnify, defend, and hold harmless the Owner, Architect, Architect's consultants, and ~~agents~~ the officers, directors, partners, consultants, subcontractors, 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, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent 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 of indemnity that would otherwise exist as to a party or person described in this Section 3.18.~~ claims (whether alleged or proven), demands, costs, losses, and/or damages, including but not limited to all fees and charges of architects, engineers, attorneys, and other professionals and all court, arbitration, or other dispute resolution costs, arising out of or relating to any claim or action, legal or equitable, caused or alleged to have been caused by the Contractor's performance of the Work, including but not limited to the Contractor's negligent performance of the Work, or any breach of the Contractor's obligations under the Contract Documents, including but not limited to the breach of any warranty provided in the Contract Documents.

§ 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.

§ 3.19 Compliance with Demolition Laws

The Contractor will, at the Contractor's expense, fully comply with all statutes and regulations regarding notification and disposal of construction and demolition debris, including, without limitation, Ohio Revised Code Chapter 3714 and the regulations enacted thereunder.

§ 3.20 Underground Utility Facilities

§ 3.20.1 The Contractor, at least two (2) working days prior to commencing any construction in an area that may involve underground utility facilities, shall give notice to the Architect and the Owner and to the registered underground utility protection services and the owners of underground utility facilities shown on the Drawings and Specifications.

§ 3.20.2 The Contractor shall notify immediately the occupants of any premises near the Work and the Architect and the Owner as to any emergency that it may create or discover. The Contractor shall notify immediately the operator

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of any underground utilities and the Architect and Owner of any break or leak in the lines of such operator or any dent, gouge, groove, or other damage to such lines or to their rating or cathodic protection, made or discovered in the course of excavation.

§ 3.21 Waivers of Claims

§ 3.21.1 Beginning with the second Application for Payment, the Contractor will submit (a) a release and/or waiver of claims, including a waiver of all lien rights, in the form included in the Contract Documents or required by the Owner for itself and each of its Subcontractors and Suppliers, regardless of tier, and (b) a complete list of its Subcontractors and Suppliers in the form included in the Contract Documents or as required by the Owner. The Owner shall not have an obligation to pay the Contractor pursuant to an Application for Payment without the corresponding releases and/or waivers of claims and the complete list of the Contractor's Subcontractors and Suppliers.

§ 3.22 Records and Audits

The Contractor shall keep full and detailed accounts and exercise such controls as may be necessary for proper financial management under the Agreement; the accounting and control systems shall be satisfactory to the Owner. The Owner and the Owner's accountants shall be afforded access to review and audit the Contractor's records, books, correspondence, instructions, drawings, receipts, subcontracts, purchase orders, vouchers, memoranda, timesheets, payroll, and other data relating to this Project, records of time spent by each person performing work on the Project, and time spent on all other projects; such time and payroll records shall include the location of services, detailed description of time and work on this Project and any other projects (redacting the client name or description to the extent necessary) and the Contractor shall preserve these for a period of four (4) years after final payment, or for such longer period as may be required by law. The Contractor shall make all such records, books, correspondence, instructions, drawings, receipts, subcontracts, purchase orders, vouchers, memoranda, timesheets, payroll, and other data relating to this Project, available to the Owner and the Owner's accountants in a location designated by the Owner at the time of the Owner's request. In the event that the Contractor's records are not available at the agreed upon time or place, or in the event that the Owner finds incomplete records or inaccurate accounting of paid expenses, the Contractor shall reimburse the Owner for its time, travel, and related expenses, and the Contractor shall reimburse the Owner the full amount of any discrepancies or overages.

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, Contractor, Owner~~ and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 ~~The~~ Unless otherwise set forth in the Agreement, the Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative ~~during construction~~ (1) during construction, (2) until the date the Architect issues the final Certificate for ~~Payment~~, and (3) with the Owner's concurrence, from time to time during the one-year period for correction of Work described in Section 12.2 and for such additional periods as the Owner and Architect may agree. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract ~~Documents~~ Documents and as authorized by the Owner.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed upon with the Owner, (1) to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the Work, and (3) 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, ~~Documents~~, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably 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~~ Except as required by its duty of care owed to the Owner, the Architect (a) will not be responsible to the Owner for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect Documents, and (b) 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 - Facilitating Contract Administration

~~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. Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with Separate Contractors under contract directly with the Owner 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 such~~ 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, material and equipment 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 or, unless otherwise specifically stated by the Architect,~~ 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 Bulletins, Change Orders,~~ and Construction Change Directives, and may ~~order authorize~~ 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;~~ 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-execute and distribute a final Certificate for Payment pursuant to Section 9.10.~~

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. ~~The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives. such Project representatives shall be consistent with these General Conditions.~~

§ 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. Copies of all Requests for Information shall be copied to the Owner by the Contractor at the time they are submitted to the Architect.

§ 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. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final as to the Contractor 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. If no agreement is made concerning the time within which interpretations required of the Architect shall be furnished in compliance with this Section 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretations until 15 days after written request is made for them and the Contractor establishes the Architect's delay in responding delayed the critical path of the Work. In its requests for information, the Contractor shall clearly identify the number of business days for the Architect to review and respond without any potential impact to the critical path or potential delay.

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 ~~Contractor shall bid the Subcontracts in accordance with Ohio law. Unless otherwise stated in the Contract Documents, Documents or the bidding requirements,~~ the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and the 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~~ fourteen (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. Failure of the Architect to provide notice within the ~~14-day~~ fourteen (14)-day period shall constitute notice of no reasonable objection. Copies of all bids or other proposals from Subcontractors or Sub-subcontractors shall, upon the request of the Owner or Architect, be submitted to the Owner and the Architect.

§ 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 objection.

§ 5.2.3 If the Owner or Architect has ~~reasonable~~ an objection to a person or entity proposed by the Contractor, the Contractor shall propose within 10 days another to whom the Owner or Architect has no ~~reasonable~~ objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 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~~ objects to such substitute. The Owner, through the Architect, may require the Contractor to change any Subcontractor previously approved and, except as provided hereafter, the Contract Sum shall be increased or decreased by the difference in cost resulting from such change. If the Contractor is in default because of the Subcontractor's performance, then the Contractor shall not be entitled to any adjustment in the Contract Sum and shall remain liable to the Owner for any damages or losses caused by such default.

§ 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 Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and ~~Contractor~~ Contractor in writing; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

~~When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.~~

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in ~~cost~~ direct costs incurred by the Subcontractor resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. ~~If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.~~

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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 Owner's own forces, and with ~~Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract and/or award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these, including those portions related to insurance and waiver of subrogation.~~ If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

~~§ 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~~ coordinate the activities of the Owner's own forces and of each ~~Separate Contractor~~ Contractor, if any, 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~~ Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall ~~have the same obligations and rights that the Contractor has been deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.~~

§ 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~~ report to the Architect apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for such 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 so report~~ 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.~~ Work, except as to defects not then reasonably discoverable.

~~§ 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.~~ The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, ~~improperly timed activities, damage to the Work or defective construction.~~ [Not Used.]

~~§ 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.

~~§ 6.2.5~~ The Owner and each Separate ~~Contractor~~ Contractor, if any, shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 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. The Architect's decision allocating the cost shall be final and binding on the Contractor and the Owner.

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. To be valid, all changes involving an increase in the Contract Sum must have any required funding certificates attached to them.

§ 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.

§ 7.1.4 All such Changes in the Work shall be submitted with any required backup documentation to the Owner and Architect in writing in advance of performance of the Work and must be approved by the Owner in writing prior to commencement of 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 Methods used in determining adjustments to the Contract Sum may include those listed in Section 7.3.3. Notwithstanding the method used to determine the adjustment to the Contract Sum, the Contractor must provide documentation to support any cost included in the request. Documentation may include invoices and time records related to the costs, but must be in a form acceptable to the Architect and Owner. Costs included in any Change Order request must be limited to those in Section 7.3.7, unless provided elsewhere in the Contract Documents or agreed to by the Owner and Architect.

§ 7.2.3 The agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including but not limited to, all direct, indirect, and cumulative costs associated with such change and any and all adjustments to the Contract Sum and Contract Time. The Contractor shall not proceed with any change in the Work without a signed Change Order, Construction Change Directive, or Minor Change in the Work notice. The Contractor's failure to timely seek and obtain such authorization as specified herein, shall constitute an irrevocable waiver by the Contractor of an adjustment to the Contract Sum or Contract Time for the related work.

§ 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, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 ~~Cost-Subject to a not-to-exceed amount, a 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 ~~7.3.4-7.3.7~~; or
- .5 Except where unit prices are applicable, that the Contractor agrees and represents to the Owner for the Owner's reliance that all Change Order or Change Directive pricing submitted by the Contractor shall be based on the Contractor's actual costs or the Contractor's reasonable estimate of what would be its actual costs plus permitted overhead and profit.

§ 7.3.4 [Not Used.]

§ 7.3.5 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.

§ 7.3.6 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 recorded as a Change Order.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment 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 amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. 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. present a true and accurate itemized accounting of all labor and material with appropriate supporting data. If the Architect prescribes a format for such accounting, the Contractor shall provide the accounting in such format. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section ~~7.3.4-7.3.7~~ shall be limited to the following:

- .1 Costs of labor, including social security, old age, and unemployment insurance, applicable payroll taxes, fringe benefits required by agreement or custom, and workers' compensation insurance, and other employee costs approved by the Architect; Architect. Contractor pricing information shall include the number of hours and rate of pay for each classification of worker;
- .2 Costs of ~~materials, materials~~ (including any and all discounts, rebates, or related credits, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, ~~minor equipment, simple scaffolds, etc.~~ whether rented from the Contractor or ~~others~~; others. Charges for certain non-owned heavy or specialized equipment may be invoiced at up to 100% of the documented rental cost. The Contractor shall submit copies of actual paid invoices to substantiate rental costs; Charges for certain Contractor-owned, heavy or specialized equipment may be invoiced at up to 100% of the cost listed by the current edition of the Associated Equipment Dealers Green Book rental rates and specifications for construction equipment. No recovery will be allowed for hand tools, minor equipment, simple scaffolds, etc. The longest period of time that the equipment is to be required for the Work shall be the basis for the pricing. Downtime due to repairs, maintenance and weather delays should not be allowed;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the ~~change; and~~ Work/change;
- .5 Costs ~~Additional reasonable costs~~ of supervision and field office personnel directly attributable to the ~~change; and~~ change; and

§ 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.**6 Total cumulative overhead and profit for all Subcontractors and Contractor**

§ 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.~~ **on any add or deduct Change Order shall not exceed 15% of the total cost of**

§ 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 recorded as a Change Order. **labor and material.**

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change order that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. ~~Architect plus the credit for overhead and profit.~~ 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, or decrease if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. 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 Contractor shall not assign any portion of the Work to another contractor whereby the Contractor would benefit directly or indirectly from the double application of charges for overhead and profit.

§ 7.3.12 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.

§ 7.3.13 The Contractor shall not be reimbursed for the following costs:

- .1 Employee Profit Sharing Plans regardless of how defined or described, the Contractor will pay these charges from Contractor profit and will not be reimbursed
- .2 Voluntary Employee Deductions (e.g., United Way Contributions, U.S. Savings Bonds, etc.)

§ 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~~ writing conspicuously marked at the top of the order as a "MINOR CHANGE IN THE WORK" and signed by the Architect and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly. 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~~ Date of Commencement of the Work is the date established in the Agreement.

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§ 8.1.3 The ~~date~~ 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 prematurely~~ commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The Date of Commencement of the Work shall not be changed by the effective date of such insurance.

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

§ 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 pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay,~~ an Excusable Delay as set forth in Section 15.1.6.3, then subject to the agreement of the Owner, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

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

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

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 total 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 so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.~~ [Not Used.]

§ 9.2 Schedule of Values

~~Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, Within 10 days of the Effective Date, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, for the Architect’s review and approval, allocating the entire Contract Sum to the various portions of the Work. The schedule of values-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, By submitting such Schedule of Values, the Contractor represents for the reliance of the Architect and the Owner that the allocation of the values to the portions of the Work is a fair and reasonable estimate of such allocation. Once approved, the Contractor will not change the allocations in the Schedule of Values without the Architect’s further approval. The Architect may from time to time require the Contractor to adjust such schedule if the Architect determines it to be in any way unreasonable or inaccurate. The Contractor then shall adjust the Schedule of Values as required by the Architect within ten (10) days. This schedule, with any adjustments approved by the Architect shall be used as a basis for reviewing the Contractor’s Applications for Payment. Any changes to the schedule of values-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. The Contractor shall include a separate line item in its Schedule of Values for its Project Superintendent.

§ 9.2.1 The Contractor will identify in its Schedule of Values a line item entitled “As-Built Drawings and Record Documents.” The Scheduled Value for this item will be one and one-half percent (1.5%) of the Contract Sum for contracts with a Contract Sum of \$1,000,000 or less, and one percent (1%) of the Contract Sum for contracts with a Contract Sum greater than \$1,000,000. When As-Built Drawings and Record Documents are received and reviewed by the Architect, and a letter is forwarded to the Owner affirming the completeness of these documents, these costs may be released. At the Owner’s discretion, the costs dedicated to this Scheduled Value may be adjusted to reflect adjustments to the Contract Sum due to approved change orders. Unless specifically approved in writing by the Owner, retained funds will not be released until As-Built Drawings and Record Drawings are received, reviewed, and deemed complete by the Architect.

§ 9.3 Applications for Payment

§ 9.3.1 At least ~~ten~~three days before the date established in Section 9.3.1.3 for each progress payment, the Contractor shall submit to the ~~Architect an itemized~~ Owner and Architect a draft Application for Payment prepared in accordance with the ~~schedule of values,~~ Schedule of Values, if required under Section 9.2, for completed portions of the Work. The ~~application~~ draft Application for Payment shall be reviewed and adjusted, if necessary, by the Architect and returned to the Contractor. The Application for Payment, as reviewed and adjusted by the Architect, shall be notarized, if required, and ~~supported by all~~ be re-submitted with all the documentation required to be submitted with such Application for Payment, and any other supporting documentation required by the Contract Documents, Contractor’s Payment Application Checklist, and by the Architect. The percentage completion of each portion of the Work shall be consistent with the then current Construction Schedule for the Project. The Application for Payment will be in the form and submitted with the number of copies and all related documents as required by the Contract Documents. The Contractor also shall submit with its Application for Payment and such other documents and/or data substantiating the Contractor’s right to payment that the Owner or Architect as Owner or Architect may require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents. The Contractor shall also provide its monthly report detailing the Project’s progress to date, projected progress for the next thirty (30) days and current project financial summary, including but not limited to:

- .1 The balance of any construction allowances and summary list of how the allowances have been expended to date.
- .2 A change order log showing any proposed, pending, and approved change order expenses to date.
- .3 Complete breakout showing the total completed and/or stored materials, labor, and equipment on the Project as of the date of the payment application, and anticipated schedule of payment applications detailing projections for the value of completed and/or stored materials, labor, and equipment, month by month, through the end of the Project.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 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.

§ 9.3.1.3 The Contractor shall submit its Application for Payment to the Architect on AIA Documents G-702 and G-703 and Certification or such other format as the Owner specifies, on or before the twenty-fifth (25th) day of each month for Work completed to that date. The Owner will issue payment to the Contractor within thirty (30) days from the date of its receipt of the certified Application for Payment from the Architect and in compliance with all of the Owner’s policies, procedures, and documentation requirements.

§ 9.3.1.4 The Contractor shall provide lien waivers from itself and all subcontractors, material suppliers, and any other party that performed work or supplied materials for the Project. Each Application for Payment shall include, in the form included in the bid package, partial and lien waivers from each of the aforementioned parties for the work performed to date on the Project and for the value of the work performed during the current billing period. A final waiver of lien in the form included in the bid package, for the total value of each subcontract shall be included with

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the final Application for Payment for each subcontract and with the Contractor's final pay application for the Project. The total of the lien waivers shall match the total amount paid to the Contractor, inclusive of all approved change orders.

§ 9.3.1.5 Partial payments to the Contractor for labor performed shall be made at the rate of 92 percent of the amount invoiced through the Application for Payment that shows the total Contract completion at 50 percent or greater, pursuant to Ohio Revised Code Section 153.12. For materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work partial payments to the Contractor shall be made at the rate of 92 percent of the amount invoiced, in accordance with the Ohio Revised Code. After the Contract is 50 percent complete as evidenced by payments in the amount of at least 50 percent of the Contract Price to the Contractor, no additional funds shall be retained from payments for labor. The Owner will withhold retainage from the amount set forth in the Application for Payment approved by the Architect, as provided in the Contract Documents.

§ 9.3.1.6 Documentation. Upon request, the Contractor immediately will supply the Owner and the Architect with such information as may be requested as to verify the amounts due to the Contractor, including but not limited to original invoices for materials and equipment and documents showing that the Contractor has paid for such materials and equipment, and so as to verify that amounts due laborers, Subcontractors, and Material Suppliers have been paid to them. The failure to provide such information shall be justification for withholding payment to the Contractor.

§ 9.3.1.7 Retainage or Other Escrow Account. Owner and Contractor acknowledge that R.C. 153.63 provides that retained and detained funds will be deposited into an escrow account governed by an escrow agreement with a third party escrow agent. If Contractor wishes to have funds so deposited, (1) Contractor must provide written notice to the Owner of the request for an escrow account prior to submission of the first pay application, (2) Contractor will be responsible for all expenses associated with the escrow agent and escrow account beyond the interest income from the account, which will be paid for out of the principal amount deposited into the escrow account, and (3) Contractor must enter into a mutually agreeable written escrow agreement with the Owner and the escrow agent. If the Contractor does not request an escrow account prior to the submission of the first pay application or, in the event Contractor does timely request an escrow account before submission of the first pay application, if Contractor cannot (or does not) agree to a mutually agreeable escrow agreement, the Contractor consents to the following: (a) Owner may deposit funds into a savings or checking account established by the Owner (which may also contain other funds); (b) Owner will not be serving in a fiduciary capacity while holding the funds; (c) Owner is not required to deposit the funds into a separate escrow account governed by an escrow agent; and (d) the foregoing satisfies the Owner's obligations under R.C. 153.63 as it pertains to both R.C. 153.12 (retained funds) and 1311.28 (detained funds).

§ 9.3.1.8 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 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.

§ 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, material suppliers, or other persons or entities that making a claim by reason of having provided labor, materials, and equipment relating to the Work. The Contractor agrees to bond off any lien filed on the real property on which the Project is located, the Owner's interest in such real property, and/or the remaining balance of the Contract Sum by providing a bond meeting the requirements of the Ohio Revised Code. The Contractor shall do so within sixty (60) days of the filing of the lien.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's ~~Application for Payment,~~ either ~~(1) properly completed Application for Payment and Contractor's Payment Application Checklist (if required) and Certification, the documentation described in the Contractor's Payment Application Checklist and Certification,~~ and such other documents and/or data substantiating the Contractor's right to payment as the Owner or Architect may require, either 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 Contractor,~~ for such amount as the Architect determines is properly due, and ~~or~~ notify the Contractor and Owner in writing 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-whole or in part 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-comprising~~ the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, and that 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. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. 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 material 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;~~ remedied or the Contractor is in default of the performance of any of its obligations under the Contract Documents including but not limited to: failure to provide sufficient skilled workers, failure to provide scheduling information as provided in Section 3.10.1, failure to prepare the Construction Schedule as provided in Section 3.10.1, failure to conform to the Construction Schedule, and/or failure to coordinate its Work with the work of other contractors, if any;
- .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 unpaid balance 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.~~ Documents; or
- .8 the Contractor is in default of the performance of any of its obligations under another contract it has with the Owner.**

§ 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.

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[Not Used.]

§ 9.5.3 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 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-material or equipment suppliers 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~~ Architect shall reflect such payment on ~~its next Application~~ the next Certificate 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~~, issue payment to the Contractor as set forth herein and shall so notify the Architect.

§ 9.6.2 The Contractor shall ~~pay each Subcontractor, no later than seven days after promptly, within the time period required by Ohio law, pay each Subcontractor upon 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. Neither the Contractor nor its Subcontractors shall withhold retainage from its Subcontractors or their sub-subcontractors beyond the retainage withheld by the Owner from the Contractor.

§ 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 material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, 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 The Contractor's payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 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.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 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 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, Owner does not pay the Contractor the amount certified by the Architect within thirty (30) days after receipt of the certified Application for Payment for the Architect and the Owner has no other basis to withhold payment pursuant to the Contract Documents, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. 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 for in the Contract Documents.

§ 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~~ and utilize the Work for its intended use. Notwithstanding anything in the Contract Documents to the contrary, this shall include, but is not limited to, start up and successful testing of all systems and equipment..

§ 9.8.1.1 Date for Substantial Completion

The Date for Substantial Completion is the Date for Substantial Completion as set forth in the Owner-Contractor Agreement. The Date for Substantial Completion shall only be changed or modified by Change Order, other Modification, or a Claim that is Finally Resolved, regardless of any dates in the Construction Schedule.

§ 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.~~ payment together with all required documents neatly bound and indexed. 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. When a specific manufacturer's warranty is required by the Specifications, the Contractor shall state in writing to the Architect that all the manufacturer's requirements for the issuance of the warranty has been completed and that the Work is ready for the Architect's and Owner's inspection. All manufacturer's warranties required for the Work shall commence as of the Date of Substantial Completion stated on the certificate issued by the Architect.

§ 9.8.3 Upon receipt of the Contractor's ~~list,~~ list and the documents required by Section 3.12.11 neatly bound and indexed, 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 Work, and the Work is Substantially Complete, 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.

§ 9.8.3.1 Time for Completion of Items on List and Remedies. The Contractor shall complete all items on the list accompanying the Architect's Certificate of Substantial Completion by the Date of Final Completion set forth in the Owner-Contractor Agreement for the Project. If the Contractor fails to do so, the Owner in its discretion may perform the Work by itself or others and the cost thereof shall be charged against the Contractor. If the balance of the Contract Sum is insufficient, the Contractor will pay the Owner the balance on demand. The Contractor's warranties and obligations under the Contract Documents shall remain in full force and effect and cover any remedial work even if performed by others. If more than one inspection by the Architect for purposes of evaluating corrected Work is required, the Contractor shall pay the additional costs and expenses incurred by the Owner as a result of more than one inspection by the Architect, and the Owner may withhold from sums due or coming due the Contractor amounts to cover such additional costs and
§-expenses.

§ 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; shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and consistent with Section 9.8.3.1 shall 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

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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 for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of Upon receipt of the Certificate of Substantial Completion from the Architect and consent of the Contractor's surety if any, the Owner shall make payment of retainage applying to the such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 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 when such portion is designated by separate agreement with the Contractor, Contractor and/or with the Architect's approval, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. In the event of a disagreement about such responsibilities, correction period, or commencement of warranties, the Architect will resolve the disagreement, and the Architect's decision will be final and binding. 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. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. 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, Architect, which shall be final and binding.

§ 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 written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, Payment and a properly completed Contractor's Payment Application Checklist (if required), all the documentation required to be submitted with such Checklist, and any other supporting documentation required by the Contract Documents or by the Architect, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, including all required documents submitted, 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.

§ 9.10.1.1 Final Completion Defined

Final Completion shall mean that the Work is complete in all respects in accordance with the Contract Documents and the Contractor has submitted to the Architect all documents required to be submitted to the Architect for final payment.

§ 9.10.1.2 Date for Final Completion

The Date for Final Completion is the Date for Final Completion as set forth in the Owner-Contractor Agreement. The Date for Final Completion shall only be changed or modified by Change Order, or other Modification, or a Claim that is Finally Resolved, regardless of any dates in the Construction Schedule.

§ 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, ~~effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner,~~ (3) a written statement that the Contractor knows of no substantial 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 a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

Unless otherwise provided in the Contract Documents, the final Application for Payment shall be itemized, and the Contractor shall ensure that the final Application for Payment transmitted to the Architect also is accompanied by the following additional documents, if not previously delivered to the Architect:

- .1 Evidence that all Completion/Punchlist items have been completed;
- .2 Where applicable, keys and keying schedule;
- .3 The documents, including as-built set of Drawings and Specifications, referred to in Section 3.3.4 in both hard copy and electronic file (in the format requested by the Owner) not otherwise required by the Contract Documents to be delivered earlier; and
- .4 Other documents required by the Contract Documents.

§ 9.10.3 If, after Substantial Completion of the Work, ~~final completion~~ Final Completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting ~~final completion,~~ Final Completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from or related to:

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
 - .2 failure of the Work to comply with the requirements of the Contract Documents;
 - .3 terms of special warranties required by the Contract Documents; ~~or~~
 - .4 audits performed by the Owner, if permitted by the Contract Documents, after final ~~payment~~ payment;
- or
- .5 any claims, damages, losses, or expenses for indemnification under Section 3.18.1.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a ~~material~~ supplier, shall constitute a waiver of claims by that payee 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~~ Contract, including compliance with OSHA and other state and federal regulations applicable to the Work. The Contractor's safety program shall be written and a copy maintained at the Project site for inspection, upon request. Neither the Owner nor the Architect accept any responsibility or

liability for the safety of the Contractor's employees or for enforcing the Contractor's safety program. Additionally, the Contractor shall comply with the Owner's rules, regulations, and policies.

§ 10.2 Safety and Health of Persons and Property

§ 10.2.1 The Contractor shall take all reasonable precautions for safety and health 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; thereby, including the Owner's employees, employees of other contractors, their subcontractors, material suppliers, and persons on the site or adjoining property;
- .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; Sub-subcontractor and/or the Work of any other contractor and the materials and equipment to be incorporated in such Work; and
- .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.

§ 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. The Contractor shall be responsible, at the Contractor's sole cost and expense, for all measures necessary to protect any property adjacent to the Project and improvements therein.

§ 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. The Contractor shall not bring any hazardous materials onto the Project site unless expressly required by the Contract Documents.

§ 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 and 10.2.1.3 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 Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18. In the event of a dispute about who is responsible for damage and loss to such property, the issue shall be submitted to the Architect and the Architect's decision shall be final and binding on the respective parties.

§ 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 the Contractor suffers injury or damage to person or property because of an act or omission of the other party, Owner, 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. the Owner is

legally responsible, the Contractor shall submit a Statement of Claim Form for such injury or damage as required by Section 15.1.

§ 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. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify-report the condition to the Owner and Architect of the condition in writing.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the ~~Contract Documents,~~ Documents upon written request, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the such material or substance or who are to perform the task of removal or safe containment of the material or substance. ~~The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. Work in the affected area shall be resumed immediately following the occurrence of any one of the following events: (i) the Owner causes remedial work to be performed that results in the hazardous substance being rendered harmless; (ii) the Owner and the Contractor, by written agreement, decide to resume performance of the Work; or (iii) the Work may safely and lawfully proceed using appropriate protective measures, as determined by a competent person employed by the Owner. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up. The term "rendered harmless" shall be interpreted to mean that exposure levels of asbestos and polychlorinated biphenyl (PCB) are less than any applicable exposure standards set forth in OSHA regulations.~~

§ 10.3.3 ~~To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, 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 in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity. [Not Used.]~~

§ 10.3.4 The Owner shall not be responsible ~~under this Section 10.3~~ for hazardous materials or substances the Contractor brings to the site unless such materials or substances are expressly required by the Contract Documents. Hazardous materials shall be identified by a Material Safety Data Sheet (MSDS). These MSDS's shall be submitted by the Contractor to the Owner prior to that material being used on the Project. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 ~~The Contractor shall~~ In addition to the Contractor's obligations in Section 3.18 and elsewhere in the Contract Documents, the Contractor shall indemnify and 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 Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the

Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred. [Not Used.]

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, without special instructions or authorization, 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. Nothing in this section will be construed as relieving Contractor from the cost and responsibility for emergencies covered hereby, which with normal diligence, planning, and the close supervision of the Work as required under the Contract, could have been foreseen or prevented. Contractor will provide Owner a list of names and telephone numbers of the designated employees for each Subcontractor to be contacted in case of emergency during non-working hours. A copy of the list will also be displayed on the jobsite.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Liability Insurance and Bonds

§ 11.1.1 The Contractor shall purchase from and maintain in an insurance company or insurance companies approved by the Owner and licensed to do business in the State of the types Ohio 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.

and limits. **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;

of liability, containing. **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;

the endorsements. **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;

and subject. **7** Claims for bodily injury or property damage arising out of completed operations, which coverage shall be maintained for no less than five (5) years following final payment; and

to the terms. **8** Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

and conditions, as described in the Agreement or elsewhere in the Contract Documents. **§ 11.1.2** The insurance required by Section 11.1.1 shall include at least the specific coverages and be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, shall be maintained without interruption from the Date of Commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.2.1 The minimum limits of liability for the required policies shall be not less than the following, unless a greater amount is required by law:

1 Commercial General Liability ("CGL"): Bodily injury (including death and emotional distress) and property damage with limits of \$ 1,000,000 each occurrence and \$ 2,000,000 aggregate. CGL shall include: (i) Premises-Operations, (ii) Explosion and Collapse Hazard, (iii) Underground Hazard, (iv) Independent Contractors' Protective, (v) Broad Form Property Damage, including Completed Operations, (vi) Contractual Liability, (vii) Products and Completed Operations, (viii) Personal Injury, (ix) Stopgap liability; (x) per project aggregate endorsement ; and (xi) an endorsement redefining "occurrence" to include property damage arising from the faulty workmanship performed by the Contractor or on the Contractors' behalf by Subcontractors.

2. Automobile Liability, covering all owned, non-owned, and hired vehicles used in connection with the Work: Bodily injury (including death and emotional distress) and property damage with a combined single limit of \$1,000,000 each accident.
3. Workers' compensation with policy limits as established by Ohio law.

shall purchase and ~~§ 11.1.2.2~~ Such policies shall be supplemented by an umbrella policy in the amount of \$5,000,000 each occurrence and \$5,000,000 aggregate.

maintain the required insurance from an ~~§ 11.1.2.3~~ The Contractor shall maintain Pollution Liability insurance with a limit for any one incident of not less than \$1,000,000 and an aggregate limit of not less than \$2,000,000.

insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in ~~§ 11.1.2.4~~ By requiring such insurance and insurance limits herein, the Owner does not represent that coverage and limits will necessarily be adequate to protect the Contractor, and such coverage and limits shall not be deemed as a limitation on the Contractor's liability under the indemnities granted to the Owner.

~~§ 11.1.2.5~~ [Not Used.]

the Contract Documents. ~~§ 11.1.2.6~~ Products and completed operations coverage shall commence with the certification of the final Certificate for Payment to the Contractor and extend for not less than the applicable Statute of Repose.

~~§ 11.1.2~~ The Contractor shall provide surety bonds. ~~11.1.2.7~~ The Contractor shall require all Subcontractors to provide Workers' Compensation, CGL, and Automobile Liability insurance with the same minimum limits specified herein, unless the Owner agrees to a lesser amount.

of the types, for such penal sums, ~~§ 11.1.2.8~~ All liability policies required in Section 11.1 shall include an additional insured endorsement naming the Owner and Architect, and any other individuals or entities identified in these General Conditions, all of whom shall be listed as additional insured, and include coverage for the respective officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insured. The additional insured endorsement shall be ISO 20 10 11 85 or its equivalent so that Completed Operations liability extends to the additional insureds.

~~§ 11.1.2.9~~ All liability policies required in Section 11.1 shall be primary and non-contributory.

and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain ~~§ 11.1.3~~ Certificates of insurance acceptable to the Owner, copies of endorsements, and other evidence of insurance requested by the Owner or any other additional insured, prior to commencement of the Work, shall be delivered to the Owner with copies to each additional insured identified in these General Conditions, when the Contractor delivers the executed counterparts of the Agreement to the Owner 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, materially changed with respect to coverage for the Project, or allowed to expire until at least 30 days' prior written notice has been given to the Owner and Contractor and to each other additional insured identified in the General Conditions to whom a certificate of insurance has been issued. 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. Prior to commencing the Work, the Contractor shall provide the Owner with the specific additional insured endorsement that names the Owner as well as copies of the waiver of subrogation and primary and contributory endorsements.

the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located. ~~§ 11.1.3.1~~ Prior to commencing the Work, the Contractor shall furnish to the Owner, through

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the Architect, one copy of each of the Certificates of Insurance required herein. The Certificates of Insurance shall specifically set forth evidence of all coverage required by Section 11.1. The form of certificate shall be the form prescribed by the Owner, which shall be the ACORD Form 25 (2009/09 or more recent). The Contractor shall furnish to the Owner copies of any endorsement that is subsequently issued by amending coverage or limits.

~~§ 11.1.3 Upon the request of any person~~**11.1.4** In no event will any failure of the Owner to receive certified copies or certificates of policies required under Section 11.1 or to demand receipt of such certified copies or certificates prior to the Contractor's commencing the Work be construed as a waiver by the Owner or the Architect of the Contractor's obligations to obtain insurance pursuant to this Article 11. The obligation to procure and maintain any insurance required by this Article 11 is a separate responsibility of the Contractor and independent of the duty to furnish a certified copy or certificate of such insurance policies.

~~or entity appearing to be~~**§ 11.1.5** If the Contractor fails to purchase and maintain, or require to be purchased and maintained, any insurance required under Section 11.1, the Owner may but shall not be obligated to, upon five (5) days written notice to the Contractor, purchase such insurance on behalf of the Contractor and shall be entitled to be reimbursed by the Contractor upon demand.

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 **§ 11.1.6** When any required insurance, due to the attainment of a normal expiration date or renewal date expires, the Contractor shall supply the Owner with Certificates of Insurance and amendatory riders or endorsements that clearly evidence the continuation of all coverage in the same manner, limits of protection, and scope of coverage as was provided by the previous policy. In the event any renewal or replacement policy, for whatever reason obtained or required, is written by a carrier other than that with whom the coverage was previously placed, or the subsequent policy differs in any way from the previous policy, the Contractor shall also furnish the Owner with a certified copy of the renewal or replacement policy unless the Owner provides the Contractor with prior written consent to submit only a Certificate of Insurance for such policy. All renewal and replacement policies shall be in form and substance satisfactory to the Owner and written by carriers acceptable to the Owner.

§ 11.1.7 Any aggregate limit under the Contractor's liability insurance shall, by endorsement, apply to the Project separately.

§ 11.1.8 The Contractor shall require each of its Subcontractors to (i) procure insurance reasonably satisfactory to the Owner and (ii) name the Owner and Architect, and any of their employees and agents, as additional insured under the Subcontractor's CGL policy. The additional insured endorsement included on the Subcontractor's CGL policy shall state that coverage is afforded the additional insureds with respect to claims arising out of operations performed by or on behalf of the Contractor. If the additional insured have other insurance that is applicable to be furnished, the loss, such other insurance shall be on an excess or contingent basis. The amount of the insurer's liability under this insurance policy shall not be reduced by the existence of such other insurance.

~~§ 11.1.4~~**11.1.9 Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Liability Insurance

~~§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. Owner, at the Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance.~~

§ 11.2.2 [Not Used.]

§ 11.2.3 [Not Used.]

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§ 11.3 Property Insurance

The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. **§ 11.3.1 Builder's Risk Insurance.** The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When, property insurance written on a builder's risk "all-risk" or equivalent policy for the Project in the amount of the initial Contract Sum, plus value of subsequent contract modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such builder's risk insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors, and Sub-subcontractors in the Project.

the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time § 11.3.1.1 The builder's risk insurance obtained shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for the Architect's and Contractor's services and expenses required as a result of such insured loss.

shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by **§ 11.3.1.1.1** If applicable, property insurance provided by the Owner shall not cover any tools, apparatus, machinery, scaffolding, hoists, forms, staging, shoring, and other similar items commonly referred to as construction equipment that may be on the site and the capital value of which is not included in the Work, nor shall such insurance cover any materials or equipment before these materials and equipment are physically incorporated into the Work. The Contractor shall make its own arrangements for any insurance it may require on such construction equipment and materials and equipment. Any policy obtained by the Contractor under this Section 11.3 and related sections shall include a waiver of subrogation in accordance with the requirements of Section 11.3.8. If the Work is located in a Special Flood Hazard Area, as defined by the Federal Emergency Management Agency, the Contractor shall provide an endorsement to the property insurance policy that provides coverage for physical loss or damage caused by flood.

the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. **§ 11.3.1.2** When it is available, the party providing the builder's risk insurance shall provide to the other party with written proof of the builder's risk insurance upon written request.

If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain **§ 11.3.1.3** If the property insurance requires deductibles, the Owner shall pay such deductibles, however, that if the cause of any loss payment under such insurance or self-insurance is the fault of Contractor, the Contractor shall pay such deductible.

the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto. **§ 11.3.1.4** The builder's risk insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance

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required by the Contract Documents, the Owner shall provide notice **§ 11.3.1.5** This property insurance must allow for partial utilization of the Work by the Owner and shall contain no partial occupancy restriction for the Project by the Owner. Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurers providing the property insurance pursuant to Section 11.4 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurance company or companies providing property insurance shall consent to such partial occupancy or use by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any partial use or occupancy.

to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the **§ 11.3.1.6 Damages to Other Property.** The maintaining of such insurance as outlined in Section 11.1 shall in no way constitute a waiver of the Contractor's legal liability for damage to any adjoining buildings or existing buildings or their contents or the Work and property of others on the site beyond the limits of insurance thus maintained. The Contractor shall hold the Owner free and harmless from any injury and damage resulting from the negligent or faulty performance of the Contract by the Contractor or its Subcontractors or others under its control or direction.

§ 11.3.1.7 This property insurance must include testing and startup.

Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; **§ 11.3.2 Boiler and Machinery Insurance.** The Owner, at the Owner's option, may purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Work, and the Owner and Contractor and any other individuals or entities identified in the Contract Documents and the officers, directors, partners, employees, agents, and consultants of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. **§ 11.3.3 Loss of Use Insurance** The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice **§ 11.3.4** If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

by the Owner shall not relieve the **§ 11.3.5** If during the Project construction period the Owner insures properties, real or personal, or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.8 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

Owner of any contractual obligation to provide **§ 11.3.6** The Owner shall maintain copies of the policies of insurance it is required to purchase and maintain hereunder at its offices and shall permit the Architect or the Contractor to inspect the policies during normal business hours and upon reasonable advance written notice.

required insurance. **§ 11.3.7** All policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Section 11.3 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has

been given to the Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with these General Conditions.

§ 11.3.11.3.8 Waivers of Subrogation

§ 11.3.1—The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement ~~or other property insurance applicable to the Project, of actual recovery of any insurance proceeds under any property insurance obtained pursuant to this Section 11.3 or other property insurance and builder's risk insurance applicable to the Work,~~ except such rights as they have to proceeds of such insurance. insurance held by the Owner in good faith. The Owner or Contractor, as appropriate, shall ~~require similar written waivers~~ require, by appropriate agreements, similar written waivers each in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, ~~subcontractors, and sub-subcontractors.~~ The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This if any, and the subcontractors, sub-subcontractors, agents, and employees of any of them. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) and whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§ 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1-11.3.9 A loss insured under the Owner's property insurance required by the Agreement shall be adjusted by the Owner as fiduciary in good faith and made payable to the Owner as fiduciary in good faith for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. ~~The Owner shall pay the Architect and Contractor 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-Subcontractors in similar manner.~~

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. ~~11.3.10~~ The Owner in good faith shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within fifteen days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved as provided in Sections 15.3 and 15.4. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner in good faith shall make settlement with insurers, or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner § 11.3.11 If required in writing by a party in interest, the Owner in good faith shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received in good faith. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.4. Performance Bond and Payment Bond

~~Contractor shall execute a Change Order for reconstruction of the damaged~~ § 11.4.1 The Contractor shall provide a contract bond to guaranty payment and performance of the Work, as required by Ohio law. When the Contractor delivers the executed counterparts of the Agreement to the Owner, the Contractor shall deliver such bond to the Owner, along with other documents as may be required.

~~or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement~~ § 11.4.1.1. If the surety on any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet with the requirements of the Agreement or Ohio law, the Contractor shall promptly notify the Owner and the Architect and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of the Contract Documents and Ohio law.

~~or the allocation of the proceeds,~~ § 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.

~~the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.~~ § 11.4.3 Material Default or Termination. If the Owner notifies the Contractor's surety that the Contractor is in material default or terminates the Contract, the surety will promptly and within 21 days investigate the claimed material default or termination. If the Owner gives a notice of material default and then terminates the Contract, the surety shall complete its investigation within 21 days of the notice of material default. As part of such investigation, the surety shall visit the offices of the Contractor, Architect, and Owner to review the available project records. If the surety proposes to take over the Work, the surety shall do so no later than the expiration of such 21 day period or 10 days after the date the Owner terminates the Contract, whichever is later. If the Owner terminates the Work, and the surety proposes to provide a replacement contractor, the replacement contractor shall be fully capable of performing the Work in accordance with the Contract Documents, including meeting all the requirements of the Contract Documents. If the Contractor is terminated, the replacement contractor shall not be the Contractor. The surety will provide the Owner with the results of its investigation, including any written report or documents. This Section 11.4.3 is in addition to the Owner's rights under Section 14.2.2 and is not intended to create any rights of the surety, including but not limited to the right to takeover the Contractor's obligations.

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.~~ costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, ~~the costs of uncovering the Work, such costs and the cost of correction, shall be at the Contractor's~~

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expense-correction shall be at the Contractor's expense unless the condition was caused by the Owner or a Separate Contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 Correction of Work

§ 12.2.1 Before or After Substantial Completion

The In addition to the rights and remedies under Section 2.5, the Contractor shall promptly correct Work rejected by the Architect or Owner for failing to conform to the requirements of the Contract Documents, whether discovered before or after 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.

§ 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~~ begin to correct it within 2 business days after receipt of written notice from the Owner to do so, so and complete such correction within 30 days after receipt of such notice, 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. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a ~~reasonable time during that period~~ 30 days after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with 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 does not limit any warranty period under these Contract Documents, 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. Any such acceptance shall be in writing and executed by a representative of the Owner who has been expressly authorized to do so.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, ~~excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4. located.~~

§ 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. Except as provided in Section 13.2.2, 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.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 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~~ Except as otherwise provided in the Contract Documents, 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 provide proper facilities at all times for inspections and tests of work by the Owner and other authorities having jurisdiction over the Project. The Contractor shall remove any water used in conducting such tests and inspections in a manner so as not to discharge the water on any portions of the Work or damage any portion of the Work. 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 (1) 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 the Agreement is executed, and (2) tests, inspections, or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.~~

~~so require.~~ **§ 13.4.1.1** If Laws and Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, the Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish the Architect the required certificates of inspection or approval. 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.

§ 13.4.1.2 The Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for the Owner's and Architect's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to the Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to the Owner and Architect. Tests required by the Contract Documents to be performed by the Contractor that require test certificates to be submitted to the Owner or Architect for acceptance shall be made by an independent testing laboratory or agency licensed or certified in accordance with Laws and

Regulations and applicable state and local statutes. In the event state license or certification is not required, testing laboratories or agencies shall meet the following applicable requirements:

- .1 “Recommended Requirements for Independent Laboratory Qualification,” published by the American Council of Independent Laboratories.
- .2 Basic requirements of ASTM E329, “Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction” as applicable.
- .3 Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Institute of Standards and Technology or accepted values of natural physical constants.

§ 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. Neither the observations by the Owner or its designated representative, nor inspections, tests, or approvals by persons other than the Contractor, shall relieve the Contractor from its obligations to perform the Work in accordance with the Contract Documents.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered in duplicate to the Owner and the Architect.

§ 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 zero percent (0%).

§ 13.6 Time Limits on Claims. As between the Owner and Contractor, the statute of limitations shall commence as provided in current Ohio law.

legal rate prevailing from time to time at the place where the Project is located. **§ 13.7 Attorney-Client Confidential and Privileged Communications.** The Contractor acknowledges and agrees that the Owner’s legal counsel may from time to time provide legal services to the Project and that in doing so may communicate with the Architect. The Contractor agrees that such communications will be privileged communications and, if there is a Claim contemplated or pending, any written communications will be confidential work product.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of ~~30~~ 90 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the ~~Work,~~ Work under direct or indirect contract with the Contractor, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;

- 3 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; or
- 4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the ~~Work~~, Work under direct or indirect contract with the Contractor, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 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 executed, ~~as well as including~~ reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- 1 ~~repeatedly~~ refuses or fails to supply enough properly skilled workers or proper materials;
- 2 fails to make payment to Subcontractors for materials or labor or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- 3 ~~repeatedly~~ disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- 4 otherwise is guilty of substantial breach of a provision of the Contract ~~Documents~~. Documents, including but not limited to failure to maintain the Construction Schedule or failure to correct defective and/or non-conforming Work.

§ 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' written notice, terminate employment of the Contractor and may, subject to any prior rights of the ~~surety~~. surety as expressly stated in the applicable surety bond:

- 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. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

As set forth in this section, the Owner's termination of the Contractor is without prejudice to any other rights and remedies of the Owner, including but not limited to the Owner's rights and remedies under the Contract Document and at law, all of which shall survive termination.

§ 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 compensation for the Architect's services and expenses made necessary thereby, and other costs or damages incurred by the Owner and not expressly waived, including but not limited to the Owner's attorneys' and consultants' fees and expenses, arising out of or related to the termination, such excess shall be paid to the Contractor. If such ~~costs~~. costs, other

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costs, and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 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. Adjustment of the Contract Sum shall include profit. 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~~ Upon three business days written notice to the Contractor and Architect, 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 case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement. Contractor shall be entitled to receive payment for Work properly executed.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The Contractor's Claims must be initiated by submitting the Statement of Claim Form ("Claim Form") included with the Contract Documents to the Architect and the Owner, properly completed in accordance with the instructions accompanying the Form and submitted within the time period under Section 15.1.3.1. The responsibility to substantiate Claims shall rest with the party making the Claim. The Contractor shall not knowingly present or cause to be presented to the Owner a false or fraudulent Claim. "Knowingly" shall have the same meaning as in Section 3729(b) USC of the Federal False Claims Act. If the Contractor knowingly presents or causes to be presented a false or fraudulent Claim, then the Contractor shall be liable to the Owner for the same civil penalty and damages as the United States Government would be entitled to recover under such Section 3729(a) USC and shall also indemnify and hold the Owner harmless from all costs and expenses, including the Owner's attorneys' and consultants' fees and expenses incurred in investigating and defending against such Claim and in pursuing the collection of such penalty, damages, and fees and expenses. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The

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~~Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2. Contractor acknowledges and agrees that the Owner and/or parties in privity of contract with the Owner may delay, interfere with, and/or disrupt the Work of the Contractor, and such actions do not constitute a breach of contract by the Owner, since the Contractor is entitled to additional compensation by properly submitting and pursuing a Claim as permitted by these General Conditions. Pending final resolution of the Claim, the Contractor shall continue performance of the Work as provided in Section 15.1.4.~~

§ 15.1.2 [Not Used.]

§ 15.1.3 Notice of Claims

~~§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and As a condition precedent to a change in the Contract Sum or the Contract Times, for each Claim the Contractor shall deliver a fully completed Statement of Claim Form, a copy of which form is a Contract Document, to the Initial Decision Maker with a copy sent to the Owner and the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence-Maker, within 10 days of the start of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.the Claim. The Contractor shall be responsible for substantiating its Claim. The Contractor's failure to deliver a fully completed Statement of Claim form shall be an irrevocable waiver of the Contractor's right to any form of additional compensation, be it in time or money, arising out of the Claim or the circumstances underlying the Claim. Further, the Contractor's obligation to deliver a fully completed Statement of Claim form within such 10 day period is a material term of the Contract Documents and provides the Owner with the opportunity to mitigate its damages.~~

~~§ 15.1.3.2 Claims by either the Owner or Contractor, the Owner, 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, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.~~

§ 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 Section 9.7 and 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.~~

~~§ 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 The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decision decisions of the Initial Decision Maker.~~

§ 15.1.4.2 [Not Used.]

§ 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. the Contractor shall submit a Statement of Claim Form as required by Section 15.1.3.1. 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 cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary. Time following proper Notice of Delay as required under Section 3.10.3.1 of these General Conditions, the Contractor shall submit a Statement of Claim Form as required by Section 15.1.3.1.~~

~~§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented the Contractor is prevented from completing any part of the Work within the Contract Time due to weather conditions and the Contractor wants additional time to complete the Work, the Contractor shall initiate a~~

Claim by submission of the Statement of Claim Form in accordance with Section 15.1.3.1. The Contractor's entitlement to additional time shall be evaluated and substantiated as provided in Section 15.1.6.2.1.

by data substantiating that **§ 15.1.6.2.1 Weather Delays**. When the Contractor is prevented from completing any part of the Work on the critical path within the Contract Time due to weather conditions, provided the Contractor properly initiates a Claim, the Contract Time will be extended by one (1) day for each work day lost due to weather that delays Work on the critical path in excess of those in the following table:

| Month | Number of Workdays Lost Due to Weather |
|-----------|--|
| January | 8 |
| February | 8 |
| March | 7 |
| April | 6 |
| May | 5 |
| June | 4 |
| July | 4 |
| August | 4 |
| September | 5 |
| October | 6 |
| November | 6 |
| December | 6 |

weather conditions were abnormal **§ 15.1.6.3 Excusable and Compensable Delays**. The delays for which the Contractor is entitled to additional time are "Excusable Delays." The only Excusable Delays are delays which the Contractor establishes were: (a) caused by the Owner or those in privity of contract with the Owner, (b) physical damage to the Project over which the Contractor has no control, (c) labor disputes beyond the control of the Contractor, (d) work days lost due to weather conditions as provided under Section 15.1.6.2, (e) concealed or unknown conditions under Section 3.7.4, and (f) other unforeseeable delays beyond the control of the Contractor and its subcontractors and suppliers of any tier.

for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction. The delays for which the Contractor is entitled to additional time and money are "Compensable Delays." The only Compensable Delays are Excusable Delays which the Contractor establishes were proximately caused by an improper action or failure to act by the Owner.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other waives Claims against the Owner 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 damages incurred by the
- ~~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, profit except anticipated profit arising directly from the Work.

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

§ 15.1.8 Settlement Offers. If the Contractor initiates a Claim, the Owner may make settlement offers to settle the Claim at any time up to the date of the trial. Such settlement offers shall be subject to Rule 408 (Compromise and Offers of Compromise) of the Ohio Rules of Evidence. If at any stage of the litigation, including any appeals, the Contractor's Claim is dismissed or found to be without merit, or if the damages awarded to the Contractor on its Claim do not exceed the Owner's last settlement offer, the Contractor shall be liable to the Owner and shall reimburse the Owner for all of the Owner's attorneys' fees and expenses, and arising out of or related to such Claim since the date of such last settlement offer.

§ 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,~~ 11.3.9, and 11.3.10, 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 any further proceeding permitted under these General Conditions of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution.~~ Maker 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~~ thirty (30) 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.

§ 15.2.2.1 Owner's Request for Documents. The Owner may request such documents and information from the Contractor as the Owner determines necessary to evaluate and comment upon the Claim. Upon receipt of such request from the Owner, the Contractor shall provide all requested documents and information within ten (10) days. Such documents and information may include but not be limited to the Contractor's Project accounting records, estimate for the Project, daily job logs, and other information from which the Contractor's Project costs may be derived. The Contractor shall provide the requested documents in the formats requested, which include both paper and electronic copies. If requested by the Owner, the electronic copies shall be provided in native computer language. To the extent permitted by law, the Owner shall keep the Project accounting records and estimate for the Project confidential. The Contractor's provision of the requested documents to the Owner in the format requested by the Owner shall be a condition precedent to any further proceeding under the Contract Documents.

Failure to provide the requested documents shall be a material breach of the Contract, and the Contractor shall indemnify the Owner for all of the Owner's costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the Contractor's failure to comply with this provision. If the Contractor fails to provide the requested documents, the Contractor shall be precluded from presenting such documents in any subsequent dispute resolution proceedings, if the data was reasonably available at the time of the request.

§ 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. If the Initial Decision Maker requests supporting data from a party and the party fails to provide it, the party thereafter shall be precluded from presenting such data in any subsequent dispute resolution proceedings, if the data was reasonably available to it at the time of the request.

§ 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

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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.~~ if both parties agreed in writing to mediate and, if mediation is not successful in resolving the matter or the parties do not agree to mediate, litigation in accordance with Section 15.4.1.

§ 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, If the Contractor does not request mediation of a written decision of the Initial Decision Maker, 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 then the Initial Decision Maker's decision becomes final and binding upon the Contractor. If the Initial Decision Maker renders a decision after litigation has been initiated, such decision may be entered as evidence, but shall not supersede the litigation proceedings unless the decision is acceptable to all parties concerned. Litigation shall be considered "initiated" upon either the service of the original complaint on the Owner or, if litigation relating to the Project has already been filed, when a motion for leave to amend the complaint to add the claim has been filed.~~

§ 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 ~~If both Parties agree to mediate, in writing, then 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. may, after initial decision by the Initial Decision Maker or 30 days after submission of the Claim to the Initial Decision Maker, be subject to mediation, pursuant to mediation procedures mutually agreed-upon by the Parties.~~

§ 15.3.2 [Not Used.]

§ 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. [Not Used.]~~

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the ~~plae~~ county 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 Litigation

§ 15.4.1 ~~If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties~~

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~~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 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 by mediation or any Claim that is not subject to mediation, shall be subject to litigation unless both parties mutually agree in writing to arbitrate the Claims. Venue for such litigation shall be exclusive in the state court of competent jurisdiction in the Court of Common Pleas, in the county in which the Project is located. The parties expressly waive the right to remove any litigation to federal court. Any Claim subject to, but not resolved by, mediation may be~~

~~§ 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. decided by arbitration if the parties mutually agree in writing. There shall be no mandatory arbitration of Claims.~~

~~§ 15.4.1.1 [Not Used.]~~

~~§ 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. [Not Used.]~~

~~§ 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. [Not Used.]~~

~~§ 15.4.4 Consolidation or Joinder [This Section is deleted in its entirety.]~~

~~§ 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). [Not Used.]~~

~~§ 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. [Not Used.]~~

~~§ 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.~~

~~[Not Used.]~~

CONTRACTOR'S PERSONAL PROPERTY TAX AFFIDAVIT
(O.R.C. § 5719.042)

State of Ohio
County of _____, ss:

_____, being first duly sworn, deposes and says that he is the
(Name)

_____ of _____ with offices located at
(Title) (Contractor)

_____, and as its duly
(Address of Contractor)

authorized representative, states that effective this ____ day of _____, 20__,

(Name of Contractor)

() is charged with delinquent personal property taxes on the general list of personal property as set forth below:

| <u>County</u> | <u>Amount</u> (include total amount penalties and interest thereon) |
|---------------|---|
| _____ County | \$ _____ |
| _____ County | \$ _____ |
| _____ County | \$ _____ |

() is not charged with delinquent personal property taxes on the general list of personal property in any Ohio county.

(Affiant)

Sworn to and subscribed before me by the above-named affiant this ____ day of _____, 20__.
The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

(Notary Public)

My commission expires
_____, 20__

**BID GUARANTY AND
CONTRACT BOND**
(O.R.C. § 153.571)

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned _____
_____ ("Contractor") as principal and _____
_____ as surety are hereby held and firmly bound unto the **Coshocton County
District Library Board of Trustees**, as obligee in the penal sum of the dollar amount of the bid submitted
by the principal to the obligee on _____, 20____, to undertake the construction of the **HVAC
Upgrades and Air Handling Unit Replacement Project** ("Project"). The penal sum referred to herein
shall be the dollar amount of the principal's bid to the obligee, incorporating any additive or deductive
Alternates made by the principal on the date referred to above to the obligee, which are accepted by the
obligee. In no case shall the penal sum exceed the amount of _____
Dollars (\$_____). (If the foregoing blank is not filled in, the penal sum will be the full amount of the
principal's bid, including add Alternates. Alternatively, if the blank is filled in the amount stated must not be
less than the full amount of the bid including add Alternates, in dollars and cents. A percentage is not
acceptable.) For the payment of the penal sum well and truly to be made, we hereby jointly and severally
bind ourselves, our heirs, executors, administrators, successors, and assigns.

Signed this _____ day of _____, 20__.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH that whereas the above named principal has
submitted a bid for work on the Project.

Now, therefore, if the obligee accepts the bid of the principal and the principal fails to enter into a
proper contract in accordance with the bid, plans, details, specifications, and bills of material; and in the
event the principal pays to the obligee the difference not to exceed ten percent (10%) of the penalty hereof
between the amount specified in the bid and such larger amount for which the obligee may in good faith
contract with the next lowest bidder to perform the work covered by the bid; or in the event the obligee does
not award the contract to the next lowest bidder and resubmits the project for bidding, the principal pays to
the obligee the difference not-to-exceed ten percent (10%) of the penalty hereof between the amount
specified in the bid, or the costs, in connection with the resubmission, of printing new contract documents,
required advertising, and printing and mailing notices to prospective bidders, whichever is less, then this
obligation shall be null and void, otherwise to remain in full force and effect; if the obligee accepts the bid
of the principal and the principal within ten (10) days after the awarding of the contract enters into a proper
contract in accordance with the bid, plans, details, specifications, and bills of material, which said contract
is made a part of this bond the same as though set forth herein.

Now also, if the said principal shall well and faithfully do and perform the things agreed by said
principal to be done and performed according to the terms of said contract; and shall pay all lawful claims
of subcontractors, materialmen, and laborers, for labor performed and materials furnished in the carrying
forward, performing, or completing of said contract; we agreeing and assenting that this undertaking shall
be for the benefit of any materialman or laborer having a just claim, as well as for the obligee herein; then
this obligation shall be void; otherwise the same shall remain in full force and effect; and surety shall
indemnify the obligee against all damage suffered by failure of the principal to perform the contract
according to its provisions and in accordance with the plans, details, specifications, and bills of material
therefor and to pay all lawful claims of subcontractors, materialmen, and laborers for labor performed or
material furnished in carrying forward, performing, or completing the contract and surety further agrees and
assents that this undertaking is for the benefit of any subcontractor, materialman, or laborer having a just
claim, as well as for the obligee; it being expressly understood and agreed that the liability of the surety for
any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The said surety hereby stipulates and agrees that no modifications, omissions, or additions in or to the terms of the said contract or in or to the plans or specifications therefore shall in any wise affect the obligations of said surety on its bond, and does hereby waive notice of any such modifications, omissions or additions to the terms of the contract or to the work or to the specifications.

Signed and sealed this _____ day of _____, 20__.

PRINCIPAL

By: _____

Printed Name & Title: _____

SURETY

By: _____

Printed Name & Title: _____

Surety's Address: _____

Surety's Telephone Number: _____

Surety's Fax Number: _____

SURETY'S AGENT

Surety's Agent's Address: _____

Surety's Agent's Telephone Number: _____

Surety's Agent's Fax Number: _____

NOTE: The Contract Bond form that follows is to be used ONLY by a bidder that is awarded a contract and submits a form of bid guaranty other than the combined Bid Guaranty and Contract Bond with its bid. If a bidder submits a combined Bid Guaranty and Contract Bond, then the bid guaranty becomes the contract bond when the contract is awarded.

AIA Bid Bond or Payment and Performance Bond forms are not acceptable for this Project.

CONTRACT BOND
(O.R.C. § 153.57)

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned ("Contractor"), as principal, and _____, as surety, are hereby held and firmly bound unto the **Coshocton County District Library Board of Trustees** ("Owner") as obligee, in the penal sum of _____ Dollars (\$____), for the payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH that whereas, the above-named principal did on the _____ day of _____, 20____, enter into a contract with the Owner for construction of the HVAC Upgrades and Air Handling Unit Replacement Project ("Project"), which said contract is made a part of this bond the same as though set forth herein:

Now, if the said Contractor shall well and faithfully do and perform the things agreed by the Contractor to be done and performed according to the terms of said contract; and shall pay all lawful claims of subcontractors, materialmen, and laborers, for labor performed and materials furnished in the carrying forward, performing, or completing of said contract; we agreeing and assenting that this undertaking shall be for the benefit of any materialman or laborer having a just claim, as well as for the obligee herein; then this obligation shall be void; otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The said surety hereby stipulates and agrees that no modifications, omissions, or additions in or to the terms of the said contract or in or to the plans or specifications therefore shall in any wise affect the obligations of said surety on its bond, and does hereby waive notice of any such modifications, omissions or additions to the terms of the contract or to the work or to the specifications.

Signed and sealed this _____ day of _____, 20____.

(PRINCIPAL)

(SURETY)

By: _____

By: _____

Printed Name & Title: _____

Printed Name & Title: _____

Surety's Address: _____

Surety's Telephone Number: _____

Surety's Fax Number: _____

NAME OF SURETY'S AGENT

Surety's Agent's Address: _____

Surety's Agent's Telephone Number: _____

Surety's Agent's Fax Number: _____



Sales and Use Tax Construction Contract Exemption Certificate

Identification of Contract:

Contractee's (owner's) name _____

Exact location of job/project _____

Name of job/project as it appears
on contract documentation _____

The undersigned hereby certifies that the tangible personal property purchased under this exemption certificate was purchased for incorporation into:

| | | | |
|--------------------------|--|--------------------------|--|
| <input type="checkbox"/> | A building used exclusively for charitable purposes by a nonprofit organization operated exclusively for charitable purposes as defined in Ohio Revised Code (R.C.) section 5739.02(B)(12); | <input type="checkbox"/> | Real property that is owned, or will be accepted for ownership at the time of completion, by the United States government, its agencies, the state of Ohio or an Ohio political subdivision; |
| <input type="checkbox"/> | Real property under a construction contract with the United States government, its agencies, the state of Ohio or an Ohio political subdivision; | <input type="checkbox"/> | A computer data center entitled to exemption under R.C. 122.175; |
| <input type="checkbox"/> | A horticulture structure or livestock structure for a person engaged in the business of horticulture or producing livestock; | <input type="checkbox"/> | A building under a construction contract with an organization exempt from taxation under section 501(c)(3) of the Internal Revenue Code of 1986 when the building is to be used exclusively for the organization's exempt purposes; |
| <input type="checkbox"/> | A house of public worship or religious education; | | |
| <input type="checkbox"/> | The original construction of a sports facility under R.C. section 307.696; | <input type="checkbox"/> | A hospital facility entitled to exemption under R.C. section 140.08; |
| <input type="checkbox"/> | Real property outside this state if such materials and services, when sold to a construction contractor in the state in which the real property is located for incorporation into real property in that state, would be exempt from a tax on sales levied by that state; | <input type="checkbox"/> | Building and construction materials and services sold for incorporation into real property comprising a convention center that qualifies for property tax exemption under R.C. 5709.084 (until one calendar year after the construction is completed). |

The original of this certificate must be signed by the owner/contractee and/or government official and must be retained by the prime contractor. Copies must be maintained by the owner/contractee and all subcontractors. When copies are issued to suppliers when purchasing materials, each copy must be signed by the contractor or subcontractor making the purchase.

Prime Contractor

Name _____
Signed by _____
Title _____
Street address _____
City, state, ZIP code _____
Date _____

Owner/Contractee

Name _____
Signed by _____
Title _____
Street address _____
City, state, ZIP code _____
Date _____

Subcontractor

Name _____
Signed by _____
Title _____
Street address _____
City, state, ZIP code _____
Date _____

Political Subdivision

Name _____
Signed by _____
Title _____
Street address _____
City, state, ZIP code _____
Date _____

STATEMENT OF CLAIM FORM

Claim No. ____ for Contractor

1. Name of Contractor: _____

2. Date written claim given: _____.

3. Contractor's representative to contact regarding the claim:

Name: _____ Title: _____

Telephone No. _____ (office) FAX No. _____

E-mail: _____

4. General description of claim:

5. Contract Documents. If the claim is based upon any part or provision in the Contract Documents, including but not limited to pages in the Drawings and/or paragraphs in the Specifications, Owner-Contractor Agreement, General Conditions or Supplementary General Conditions, state upon which parts or provisions the claim is based:

6. Delay claims:

6.1 Date delay commenced: _____

6.2 Duration or expected duration of the delay: _____

6.3 Apparent cause of the delay and part of critical path affected:

6.4 Expected impact of the delay and recommendations for minimizing such impact:

7. Additional compensation. Set forth in detail all additional compensation to which the Contractor believes it is entitled with respect to this claim:

8. Instructions for Completing the Statement of Claim Form ("Instructions"). The Instructions are incorporated in this Form.

9. Truth of Claim. By submitting this claim, the Contractor and its representative certify that after conscientious and thorough review and to the best of his or her knowledge and belief a) the Contractor has complied fully with the Instructions, b) the information in this State of Claim is accurate, c) the Contractor is entitled to recover the compensation in paragraph 7, and d) the Contractor has not knowingly presented a false or fraudulent claim. The Contractor by its authorized representative must acknowledge this Statement of Claim before a notary public.

CONTRACTOR: _____

By: _____

Name and Title: _____

Date: _____

CONTRACTOR'S ACKNOWLEDGMENT

State of _____,

County of _____, ss:

_____ first being sworn, states that after conscientious and thorough review, the statements made in attached Statement of Claim Form are complete and true to the best of his or her knowledge and belief.

Sworn to before me a notary public by _____ on _____, 20___. The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

Notary Public

WHEN COMPLETED, FORWARD A COPY OF THIS NOTICE AND STATEMENT OF CLAIM FORM TO THE OWNER AND DESIGN PROFESSIONAL.

INSTRUCTIONS FOR COMPLETING THE STATEMENT OF CLAIM FORM

1. Completing the Statement of Claim Form ("Claim Form") is a material term of the Contract. The Claim Form tells the Owner and Design Professional that the Contractor is making a Claim and that they need to act promptly to mitigate the effects of the occurrence giving rise to the Claim. The Claim Form also provides them with information so that they can mitigate such effects. The Contractor acknowledges that constructive knowledge of the conditions giving rise to the Claim through job meetings, correspondence, site observations, etc. is inadequate notice, because knowledge of these conditions does not tell the Owner and Design Professional that the Contractor will be making a Claim and most often is incomplete.
2. If the space provided in the Claim Form is insufficient, the Contractor, as necessary to provide complete and detailed information, must attach pages to the Claim Form with the required information.
3. Paragraph 4. The Contractor must state what it wants, *i.e.*, time and/or compensation, and the reason why it is entitled to time and/or compensation.
4. Paragraph 5. The Contractor must identify the exact provisions of the Contract Documents it is relying on in making its Claim. For example, if the Claim is for a change in the scope of the Contractor's Work, the Contractor must identify the specific provisions of the Specifications, and the Plan sheets and details that provide the basis for the scope change.
5. Paragraph 6. This paragraph applies to delay claims, including delays that the Contractor believes result in constructive acceleration. The Contractor must identify the cause of the delay, party or parties responsible, and what the party did or did not do that caused the delay, *i.e.*, specific work activities. The Contractor acknowledges that general statements are not sufficient, and do not provide the Owner with sufficient information to exercise the remedies available to the Owner or to mitigate the effects of the delay.

For example, if the Contractor claims a slow response time on submittals caused a delay, the Contractor must identify the specific submittals, all relevant dates, and then show on the applicable schedule, by circling or highlighting, the activities immediately affected by the delays. Also for example, if the Contractor claims it was delayed by another Contractor, the Contractor must identify the delaying Contractor, specifically what the delaying Contractor did or did not do that caused the delay, and then show the applicable schedule, by circling or highlighting, the activities immediately affected by the delays. Further by example, if the Contractor seeks an extension of time for unusually severe weather, the Contractor must submit comparative weather data along with a record of the actual weather at the job site and job site conditions.

6. Paragraph 6.4. Time is of the essence under the Contract Documents. If there is a delay, it is important to know what can be done to minimize the impact of the delay. It therefore is important that the Contractor provide specific recommendations on how to do so.
7. Paragraph 7. The Contractor must provide a specific and detailed breakdown of the additional compensation it seeks to recover. For future compensation, the Contractor shall provide its best estimate of such compensation.
8. Paragraph 8 and Acknowledgment. By submitting this Claim, the Contractor and its representative certify that after conscientious and thorough review and to the best of his or her knowledge and belief a) the Contractor has complied fully with the Instructions, b) the information in this Claim Form is accurate, c) the Contractor is entitled to recover the compensation in paragraph 7, and d) the Contractor has not knowingly presented a false or fraudulent claim. The Contractor by its authorized representative must acknowledge this Statement of Claim before a notary public.

End of Instructions

CERTIFICATE OF SUBSTANTIAL COMPLETION

Project:
HVAC Upgrades and Air Handling Unit
Replacement Project

Contract For:
General Contract

Owner:
Coshocton County District Library Board of
Trustees

CONTRACTOR: [insert name and address]

The Design Professional hereby certifies that the Date for Substantial Completion of the Contractor’s Work as set forth in the Owner-Contractor Agreement is:

(Insert Date for Substantial Completion of the Work)

The Design Professional hereby certifies that the Date for Substantial Completion in the Contractor’s Agreement with the Owner (the “Agreement”), as extended by Change Orders and Claims submitted by the Contractor that have been Finally Resolved, as defined below, is:

- 1. Date for Substantial Completion in the Agreement (above): _____
- 2. Additional days added to Date for Substantial Completion by Change Order: _____
- 3. Additional days added by Claims that have been Finally Resolved: _____
- 4. Date for Substantial Completion in the Contract Adjusted by days under No. 2 and No. 3 _____

“Finally Resolved” means that the Design Professional has made a decision (or declined to make a decision) on the Claim under the General Conditions and that any litigation regarding the Claim has been concluded.

The Design Professional certifies that the Contractor’s Work to the best of the Design Professional’s knowledge, information, and belief was Substantially Complete, as Substantial Completion is defined in the Contract Documents, on _____.

The Design Professional hereby certifies that the difference between (a) the Date for Substantial Completion adjusted by the days under No. 2 and No. 3 above and (b) the date the Contractor’s Work was Substantially Complete is _____ days.

NOTICES OF DELAY. The Design Professional hereby certifies that all “NOTICES OF DELAY” submitted by the Contractor and described in the General Conditions are attached to this Certificate. This certification is solely for the purpose of identifying all “NOTICES OF DELAY” submitted by the Contractor and is not intended to imply that any of these NOTICES OF DELAY were properly submitted in accordance with Contract Documents or are valid.

STATEMENT OF CLAIM FORMS. The Design Professional hereby certifies that all Statement of Claim Forms described in the General Conditions and submitted by the Contractor are attached to this Certificate. This certification is solely for the purpose of identifying all Statement of Claim Forms submitted by the Contractor and is not intended to imply that any of these Statement of Claim Forms were properly submitted in accordance with Contract Documents or are valid.

PUNCHLIST ITEMS. A list of items to be completed by the Contractor is attached to this Certificate. The failure to include items on this list does not change the responsibility of the Contractor to complete its Work in accordance with the Contract Documents. The Contractor shall complete all items on the Punchlist in accordance with the Contract Documents.

Security, maintenance, utilities, damage to the Work and insurance are the responsibility of the Owner and the Contractor based on their operations pursuant to final completion of the Work.

Copies of this Certificate were provided to the Contractor and the Owner on _____

Signature: _____

Date: _____

**CONTRACTOR'S AFFIDAVIT AND CERTIFICATION WITH LIST OF SUBCONTRACTORS
AND SUPPLIERS WITH ANY AMOUNTS WITHHELD**

PROJECT:
**HVAC Upgrades and Air Handling Unit
Replacement Project**

CONTRACTOR:

In Support of PAYMENT APPLICATION No.: _____

For the Period Through: _____

STATE OF _____ :
: SS,
COUNTY OF _____ :

The undersigned after first being sworn swears that a) all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment; b) set forth below is a complete list of its Subcontractors and Suppliers; and c) set forth below is a complete description of all amounts withheld from any Subcontractor or Supplier and the reason why. Attach additional sheets if necessary.

| Typed or Printed Name of Subcontractor or Supplier | Address of Subcontractor or Supplier | Telephone Number of Subcontractor or Supplier |
|--|--------------------------------------|---|
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WITHHOLDINGS FROM SUBCONTRACTORS AND/OR SUPPLIERS:

| Typed or Printed Name of Subcontractor or Supplier | Amount Withheld | Reason for Withholding |
|--|-----------------|------------------------|
| | | |
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| | | |

Moreover, Contractor certifies that, except for as set forth immediately above, Contractor has paid all of its subcontractors and suppliers who were due to be paid with the proceeds of the prior Application for Payment and Contractor acknowledges that Owner is relying upon such certification when paying Contractor the amount asked for in the payment application that this Affidavit and Certification supports.

CONTRACTOR: [insert name]

BY: _____
(Signature of authorized representative)

NOTARY PUBLIC

Subscribed and sworn to before me on this date by _____ on behalf of _____.
The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

Signature of Notary Public

Notary Public: _____

My Commission Expires: _____

**CONTRACTOR'S WAIVER & RELEASE AFFIDAVIT
("AFFIDAVIT")**

Project: HVAC Upgrades and Air Handling Unit Replacement Project

The undersigned hereby acknowledges receipt of payment for all Work on the Project through the date of the prior Application for Payment by the **Coshocton County District Library Board of Trustees** (the "Owner") with which it has a contract for the Project.

In return for said payment, and/or pursuant to certain contractual obligations of the undersigned, the undersigned hereby waives and releases any rights it has or may have through the date of the last Application for Payment to any and all types of claims relating to the Project, including without limitation claims of payment, Mechanic's Lien, stop notice, equitable lien, labor and material bond, breach of contract or unjust enrichment, or any other claim against the Owner, for any labor, materials, or equipment the undersigned may have delivered or provided to the Project, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned further certifies that this Affidavit covers claims by all contractors, subcontractors, and suppliers who may have provided any labor, material, or equipment to the Project through the undersigned or at the undersigned's request. The undersigned acknowledges that all such contractors, subcontractors, sub-subcontractors and suppliers have signed an affidavit in the form of this Affidavit releasing any and all claims against the Owner, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned hereby represents and warrants that it has paid any and all welfare, pension, vacation or other contributions required to be paid on account of the employment by the undersigned of any laborers on the Project.

This Affidavit is for the benefit of, and may be relied upon by the Owner. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, work of improvement, and real property from any and all claims, or liens that are or should have been released in accordance with this Affidavit.

Company Name

Authorized Signature (Company Officer)

Title

Date

State of: _____ County of _____

Subscribed and sworn to before me this _____
day of _____. The notarial
act certified hereby is a jurat. An oath or affirmation was
administered to the signer with regard to the notarial act
certified to hereby.

Notary Public: _____

My Commission Expires: _____

**SUBCONTRACTORS, SUPPLIERS
WAIVER & RELEASE AFFIDAVIT
("AFFIDAVIT")**

Project: HVAC Upgrades Project and Air Handling Unit Replacement Project

The undersigned hereby acknowledges receipt of payment for all Work on the Project through the date of the prior Application for Payment by the _____ ("Contractor") with which it has a contract.

In return for said payment, and/or pursuant to certain contractual obligations of the undersigned, the undersigned hereby waives and releases any rights it has or may have through the date of the Contractor's last Application for Payment and to any and all types of claims relating to the Project, including without limitation claims of payment, Mechanic's Lien, stop notice, equitable lien, labor and material bond, breach of contract or unjust enrichment, or any other claim against the Contractor, the Contractor's surety, and/or the **Coshocton County District Library Board of Trustees** (the "Owner"), for any labor, materials, or equipment the undersigned may have delivered or provided to the Project, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form, a copy of which has been delivered to the Owner. The undersigned further certifies that this Affidavit covers claims by all contractors, subcontractors and suppliers through the date of the Contractor's last Application for Payment who may have provided any labor, material, or equipment to the Project through the undersigned or at the undersigned's request. The undersigned acknowledges that all such contractors, subcontractors, sub-subcontractors and suppliers have signed an affidavit in the form of this Affidavit releasing any and all claims against the Contractor, the Contractor's surety, and/or the Owner, except for any Claims made by properly and timely submitting a Statement of Claim form a copy of which has been delivered to the Owner. The undersigned hereby represents and warrants that it has paid any and all welfare, pension, vacation or other contributions required to be paid on account of the employment by the undersigned of any laborers on the Project.

The undersigned agrees that upon receipt of the payment from the Contractor with respect to the Contractor's current Application for Payment, it shall, if applicable, immediately execute and cause to be filed or recorded a legally effective Satisfaction of Lien, Release of Lien, or any other legal instrument necessary to cause prejudicial dismissal and release of any lien, encumbrance, lawsuit, or other claim against the Contractor, the Contractor's surety and the Owner, the property where the Project is located, and/or any surety bond posted by the Contractor or the Owner to the extent of the foresaid payment. Upon request of the Contractor, the undersigned shall provide proof of having complied with this obligation.

This Affidavit is for the benefit of, and may be relied upon by, the Contractor, the Contractor's surety and the Owner. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, its Work, and real property from any and all claims, or liens that are or should have been released in accordance with this Affidavit and from any liability, cost, or expense incurred as a result of any breach of this Affidavit by the undersigned.

Company Name

Authorized Signature (Company Officer)

Title

Date

State of: _____ County of _____

Subscribed and sworn to before me this _____ day of _____. The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

Notary Public: _____

My Commission Expires: _____

**CONTRACTOR'S FINAL WAIVER & RELEASE AFFIDAVIT
("AFFIDAVIT")**

Project: HVAC Upgrades and Air Handling Unit Replacement Project

In consideration for payment received from the **Coshocton County District Library Board of Trustees** (the "Owner") in the amount requested in Contractor's Final Application for Payment to the Owner, the receipt of which is hereby acknowledged, the undersigned Contractor hereby waives and releases any rights it has or may have to any and all types of claims relating to the Project, including without limitation claims of payment, Mechanic's Lien, stop notice, equitable lien, labor and material bond, breach of contract or unjust enrichment, or any other claim against the Owner, for any labor, materials, or equipment the undersigned may have delivered or provided to the Project, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned further certifies that this Affidavit covers claims by all contractors, subcontractors, and suppliers who may have provided any labor, material, or equipment to the Project through the undersigned or at the undersigned's request. The undersigned acknowledges that all such contractors, subcontractors, sub-subcontractors and suppliers have signed an affidavit in the form of this Affidavit releasing any and all claims against the Owner, except for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned hereby represents and warrants that it has paid any and all welfare, pension, vacation or other contributions required to be paid on account of the employment by the undersigned of any laborers on the Project.

This Affidavit is for the benefit of, and may be relied upon by the Owner. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, work of improvement, and real property from any and all claims, or liens that are or should have been released in accordance with this Affidavit.

Company Name

Authorized Signature (Company Officer)

Title

Date

State of: _____ County of _____

Subscribed and sworn to before me this _____
day of _____. The notarial
act certified hereby is a jurat. An oath or affirmation was
administered to the signer with regard to the notarial act
certified to hereby.

Notary Public: _____

My Commission Expires: _____

**SUBCONTRACTORS, SUPPLIERS
FINAL WAIVER & RELEASE AFFIDAVIT
("AFFIDAVIT")**

Project: HVAC Upgrades and Air Handling Unit Replacement Project

Upon receipt of payment in the amount of \$ _____ received from _____ ("Prime Contractor") the undersigned Subcontractor or Supplier waives and relinquishes all rights of lien or claim that it may have either in law or equity (including but not limited to rights under Ohio Mechanics' Lien Laws, O.R.C. 1311.01 *et seq.*) with respect to the construction project known as HVAC Upgrades and Air Handling Unit Replacement Project ("the Project"), for all labor, all equipment, and/or materials provided to or on behalf of the Project throughout its entirety, except for claims previously made pursuant to the agreement in place between Subcontractor or Supplier and Prime Contractor, and any lien previously perfected and remaining unreleased.

The undersigned Subcontractor or Supplier acknowledges and agrees that such payment represents final payment in full for all such labor, equipment and/or materials including retainage, if any, and that the Subcontractor or Supplier has completed its work on the Project. The undersigned Subcontractor or Supplier certifies that all amounts have been paid by the Subcontractor or Supplier for all work or materials furnished by others to the Subcontractor or Supplier for which the Subcontractor or Supplier has received previous payments from Prime Contractor, and Subcontractor or Supplier acknowledges that Prime Contractor is now making payment to the Subcontractor or Supplier in reliance upon such certification. The undersigned Subcontractor or Supplier further certifies that it will pay all amounts lawfully owing for all work or materials furnished by others to the Subcontractor or Supplier with the payment received from Contractor referenced herein.

This Affidavit is for the benefit of, and may be relied upon by, the Contractor, the Contractor's surety and the Coshocton County District Library Board of Trustees. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, its Work, and real property from any and all claims, or liens that are or should have been released in accordance with this Affidavit and from any liability, cost, or expense incurred as a result of any breach of this Affidavit by the undersigned.

IN WITNESS WHEREOF, the undersigned has caused this Affidavit to be executed by its authorized representative as of the date indicated below.

THE INDIVIDUAL SIGNING THIS AFFIDAVIT REPRESENTS THAT HE/SHE IS AUTHORIZED TO DO SO.

SUBCONTRACTOR OR SUPPLIER:

Company Name

Authorized Signature (Company Officer)

Title

Date

State of: _____ County of _____

Subscribed and sworn to before me this _____ day of _____. The notarial act certified hereby is a jurat. An oath or affirmation was administered to the signer with regard to the notarial act certified to hereby.

Notary Public: _____

My Commission Expires: _____

Prevailing Wage Rates

(To be provided by Owner's Prevailing Wage Coordinator)

Prevailing Wage Determination Cover Letter

County: COSHOCTON ▼
Determination Date: 12/19/2022
Expiration Date: 03/19/2023

THE FOLLOWING PAGES ARE PREVAILING RATES OF WAGES ON PUBLIC IMPROVEMENTS FAIRLY ESTIMATED TO BE MORE THAN THE AMOUNT IN O.R.C. SEC. 4115.03 (b) (1) or (2), AS APPLICABLE.

Section 4115.05 provides, in part: "Where contracts are not awarded or construction undertaken within ninety days from the date of the establishment of the prevailing wages, there shall be a redetermination of the prevailing rate of wages before the contract is awarded." The expiration date of this wage schedule is listed above for your convenience only. This wage determination is not intended as a blanket determination to be used for all projects during this period without prior approval of this Department.

Section 4115.04, Ohio Revised Code provides, in part: "Such schedule of wages shall be attached to and made a part of the specifications for the work, and shall be printed on the bidding blanks where the work is done by contract..."

The contract between the letting authority and the successful bidder shall contain a statement requiring that mechanics and laborers be paid a prevailing rate of wage as required in Section 4115.06, Ohio Revised Code.

The contractor or subcontractor is required to file with the contracting public authority upon completion of the project and prior to final payment therefore an affidavit stating that he has fully complied with Chapter 4115 of the Ohio Revised Code.

The wage rates contained in this schedule are the "Prevailing Wages" as defined by Section 4115.03, Ohio Revised Code (the basic hourly rates plus certain fringe benefits). These rates and fringes shall be a minimum to be paid under a contract regulated by Chapter 4115 of the Ohio Revised Code by contractors and subcontractors. The prevailing wage rates contained in this schedule include the effective dates and wage rates currently on file. In cases where future effective dates are not included in this schedule, modifications to the wage schedule will be furnished to the Prevailing Wage Coordinator appointed by the public authority as soon as prevailing wage rates increases are received by this office.

"There shall be posted in a prominent and accessible place on the site of work a legible statement of the Schedule of Wage Rates specified in the contract to the various classifications of laborers, workmen, and mechanics employed, said statement to remain posted during the life of such contract." Section 4115.07, Ohio Revised Code.

Apprentices will be permitted to work only under a bona fide apprenticeship program if such program exists and if such program is registered with the Ohio Apprenticeship Council.

Section 4115.071 provides that no later than ten days before the first payment of wages is due to any employee of any contractor or subcontractor working on a contract regulated by Chapter 4115, Ohio Revised Code, the contracting public authority shall appoint one of his own employees to act as the prevailing wage coordinator for said contract. The duties of the prevailing wage coordinator are outlined in Section 4115.071 of the Ohio Revised Code.

Section 4115.05 provides for an escalator in the prevailing wage rate. Each time a new rate is established, that rate is required to be paid on all ongoing public improvement projects.

A further requirement of Section 4115.05 of the Ohio Revised Code is: "On the occasion of the first pay date under a contract, the contractor shall furnish each employee not covered by a collective bargaining agreement or understanding between employers and bona fide organizations of Labor with individual written notification of the job classification to which the employee is assigned, the prevailing wage determined to be applicable to that classification, separated into the hourly rate of pay and the fringe payments, and the identity of the prevailing wage Coordinator appointed by the public authority. The contractor or subcontractor shall furnish the same notification to each affected employee every time the job classification of the employee is changed."

Work performed in connection with the installation of modular furniture may be subject to prevailing wage.

THIS PACKET IS NOT TO BE SEPARATED BUT IS TO REMAIN COMPLETE AS IT IS SUBMITTED TO YOU. (Reference guidelines and forms are included in this packet to be helpful in the compliance of the Prevailing Wage law.)

wh1500

Prevailing Wage Rate Skilled Crafts

Name of Union: **Asbestos Local 207 OH**

Change # : LCN01-2018fbLoc207OH

Craft : Asbestos Worker Effective Date : 08/23/2018 Last Posted : 08/23/2018

| | BHR | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|-----------------------|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | |
| Asbestos Abatement | \$25.50 | \$7.25 | \$6.45 | \$0.65 | \$0.00 | \$0.00 | \$0.07 | \$0.00 | \$0.00 | \$39.92 | \$52.67 |
| Trainee | \$16.50 | \$7.25 | \$1.50 | \$0.65 | \$0.00 | \$0.00 | \$0.07 | \$0.00 | \$0.00 | \$25.97 | \$34.22 |

Special Calculation Note :

Ratio :

3 Journeymen to 1 Trainee

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ASHTABULA*, ATHENS, AUGLAIZE, BROWN, BUTLER*, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARDIN, HARRISON, HIGHLAND, HOCKING, HOLMES, HURON, KNOX, LAKE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MIAMI, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PORTAGE, PREBLE, RICHLAND, ROSS, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN*, WAYNE

Special Jurisdictional Note : Butler County:(townships of Fairfield,Hanover,Liberty,Milford,Morgan,Oxford,Ripley,Ross,StClair,Union & Wayne.) (Lemon & Madison) Warren County: (townships of: Deerfield, Hamilton, Harlan, Salem, Union & Washington). (Clear Creek, Franklin, Mossie, Turtle Creek & Wayney). Ashtabula County: (post offices & townships of Ashtabula, Austinburg, Geneva, Harperfield, Jefferson, Plymouth & Saybrook) (townships of Andover, Cherry Valley, Colbrook, Canneaut, Denmark, Dorset, East Orwell, Hartsgrove, Kingville, Lenox, Monroe,Morgan,New Lyme,North Kingsville, Orwell, Pierpoint, Richmond Rock Creek, Rome, Sheffield, Trumbull, Wayne, Williamsfield & Windsor) Erie County:(post offices & townships of Berlin, Berlin Heights,Birmingham,Florence ,Huron, Milan, Shinrock & Vermillion)

Details :

Asbestos & lead paint abatement including,but not limited to the removal or encapsulation of asbestos & lead paint,all work in conjunction with the preparation of the removal of same & all work in conjunction with the

clean up after said removal. The removal of all insulation materials, whether they contain asbestos or not, from mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) is recognized as being the exclusive work of the Asbestos Abatement Workers.

On all mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) that are going to be demolished, the removal of all insulating materials whether they contain asbestos or not shall be the exclusive work of the Laborers.

An Abatement Journeyman is anyone who has more than 300 hours in the Asbestos Abatement field.

Prevailing Wage Rate Skilled Crafts

Name of Union: Asbestos Local 3 Heat & Frost Insulators

Change # : LCN01-2022sksLoc3

Craft : Asbestos Worker Effective Date : 09/21/2022 Last Posted : 09/21/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|----------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Asbestos Insulation Worker | \$41.23 | | \$14.40 | \$10.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$65.63 | \$86.25 |
| Fire Stop Specialist | \$41.23 | | \$14.40 | \$10.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$65.63 | \$86.25 |
| Fire Stop Technician | \$34.10 | | \$14.40 | \$4.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$52.50 | \$69.55 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st year | 50.20 | \$20.70 | \$14.40 | \$1.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$36.10 | \$46.45 |
| 2nd year | 63.68 | \$26.26 | \$14.40 | \$2.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$42.66 | \$55.78 |
| 3rd year | 69.25 | \$28.55 | \$14.40 | \$3.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$45.95 | \$60.23 |
| 4th year | 82.70 | \$34.10 | \$14.40 | \$4.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$52.50 | \$69.55 |

Special Calculation Note : There are no special calculations for this classification.

Ratio :

3 Journeymen to 1 Apprentice per shop

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, ASHTABULA*, CARROLL, COLUMBIANA, COSHOCTON, CUYAHOGA, ERIE*, GEAUGA, HARRISON, HOLMES, HURON, LAKE, LORAIN, MAHONING, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, WAYNE

Special Jurisdictional Note : Ashtabula (the townships of Ashtabula, Austinburg, Geneva, Jefferson, Plymouth & Saybrook), The remainder of Ashtabula County will be considered open counties on a 90 day basis automatically renewable unless revoked by the Union upon 15 day written notice by the employers. Erie (to Sandusky limits)

Details :

Mechanics & apprentices engaged in the manufacture, fabrication, assembling, molding, handling, erection, spraying, pouring, mixing, hanging, clean-up, preparation, application, adjusting, alteration, repairing, dismantling, reconditioning, testing & maintenance of Heat & Frost Insulation such as Magnesia, Asbestos, Hair Felt, Wool Felt, Cork, Mineral Wool, Infusorial Earth, Mercerized Silk, Flax, Fiber, Fire Felt, Asbestos Paper, Asbestos Curtain, Asbestos Millboard, Fiberglass, Foam glass, Styrofoam, Polyurethane, fire stopping, smoke stopping, all recyclable material, soundproofing, all

penetrations, any flexible or rigid fireproofing, all jacketing systems including metal, lead, and PVC or other material.

Prevailing Wage Rate Skilled Crafts

Name of Union: Asbestos Local 84 Heat & Frost Insulators

Change # : LCN01-2018fbLoc84

Craft : Asbestos Worker Effective Date : 06/06/2018 Last Posted : 06/06/2018

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|----------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Asbestos Insulation Worker | \$31.47 | | \$9.49 | \$8.36 | \$0.36 | \$0.00 | \$3.39 | \$0.24 | \$0.00 | \$0.00 | \$53.31 | \$69.04 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st Year | 50.00 | \$15.74 | \$9.49 | \$8.36 | \$0.36 | \$0.00 | \$3.39 | \$0.24 | \$0.00 | \$0.00 | \$37.58 | \$45.44 |
| 2nd Year | 60.00 | \$18.88 | \$9.49 | \$8.36 | \$0.36 | \$0.00 | \$3.39 | \$0.24 | \$0.00 | \$0.00 | \$40.72 | \$50.16 |
| 3rd Year | 70.00 | \$22.03 | \$9.49 | \$8.36 | \$0.36 | \$0.00 | \$3.39 | \$0.24 | \$0.00 | \$0.00 | \$43.87 | \$54.88 |
| 4th Year | 80.00 | \$25.18 | \$9.49 | \$8.36 | \$0.36 | \$0.00 | \$3.39 | \$0.24 | \$0.00 | \$0.00 | \$47.02 | \$59.60 |

Special Calculation Note : Other is Industry and Labor Management Fund

Ratio :

3 Journeymen to 1 Apprentice per shop

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, ASHTABULA*, CARROLL, COLUMBIANA, COSHOCTON, ERIE*, HARRISON, HOLMES, MAHONING, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, WAYNE

Special Jurisdictional Note : Ashtabula County: except for the townships of Ashtabula, Austinburg, Geneva, Harpersfield, Jefferson, Plymouth and Saybrook. Erie except Sandusky city limits.

Details :

The removal of all insulation materials, whether they contain asbestos or not, from mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) is recognized as being the exclusive work of the Asbestos Workers. On all mechanical systems (pipes, boilers, ducts, flues, breaching, etc.) that are going to be demolished, the removal of all insulating materials whether they contain asbestos or not shall be the exclusive work of the Laborers.

Prevailing Wage Rate Skilled Crafts

Name of Union: **Boilermaker Local 744**

Change # : LCNO1-2019fbLoc744

Craft : Boilermaker Effective Date : 04/03/2019 Last Posted : 04/03/2019

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|----------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Boilermaker | \$38.05 | | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$67.76 | \$86.78 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 6 months | 70.02 | \$26.64 | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$56.35 | \$69.67 |
| 2nd 6 months | 72.52 | \$27.59 | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$57.30 | \$71.10 |
| 3rd 6 months | 75.00 | \$28.54 | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$58.25 | \$72.52 |
| 4th 6 months | 77.51 | \$29.49 | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$59.20 | \$73.95 |
| 5th 6 months | 80.00 | \$30.44 | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$60.15 | \$75.37 |
| 6th 6 months | 85.03 | \$32.35 | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$62.06 | \$78.24 |
| 7th 6 months | 90.00 | \$34.25 | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$63.96 | \$81.08 |
| 8th 6 months | 95.00 | \$36.15 | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$65.86 | \$83.93 |
| Helper | 60.00 | \$22.83 | \$7.07 | \$16.07 | \$0.74 | \$0.00 | \$5.08 | \$0.75 | \$0.00 | \$0.00 | \$52.54 | \$63.96 |

Special Calculation Note : Other is Supplemental Health

Ratio :

5 Journeymen to 1 Apprentice to 1 Helper

Jurisdiction (* denotes special jurisdictional note) :

ASHTABULA, CARROLL, COSHOCTON, CUYAHOGA, GEAUGA, HARRISON, HOLMES, LAKE, LORAIN, MAHONING, MEDINA, PORTAGE, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Bricklayer Local 44

Change # : LCN01-2022sksLoc44

Craft : Bricklayer Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---------------------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Bricklayer | \$30.49 | | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$48.12 | \$63.36 |
| Block Layer Stone Mason | \$30.49 | | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$48.12 | \$63.36 |
| Refractory Specialist | \$31.37 | | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$49.00 | \$64.68 |
| Gunnite Nozzleman | \$31.37 | | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$49.00 | \$64.68 |
| Cement Mason | \$30.49 | | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$48.12 | \$63.36 |
| Pointer Caulker Cleaner | \$30.49 | | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$48.12 | \$63.36 |
| Mason Trainee | | | | | | | | | | | | |
| 1-90 Days | \$15.25 | | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$15.25 | \$22.87 |
| 91-365 Days | \$15.25 | | \$9.27 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$24.52 | \$32.14 |
| 366 Plus Days | \$18.29 | | \$9.27 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$27.56 | \$36.71 |
| Apprentice Percent | | | | | | | | | | | | |
| 1st 6 months | 60.00 | \$18.29 | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$35.92 | \$45.07 |
| 2nd 6 months | 65.00 | \$19.82 | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$37.45 | \$47.36 |
| 3rd 6 months | 70.00 | \$21.34 | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$38.97 | \$49.64 |
| 4th 6 months | 75.00 | \$22.87 | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$40.50 | \$51.93 |
| 5th 6 months | 80.00 | \$24.39 | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$42.02 | \$54.22 |
| 6th 6 months | 85.00 | \$25.92 | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$43.55 | \$56.50 |

| | | | | | | | | | | | | |
|--------------|-------|---------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| 7th 6 months | 90.00 | \$27.44 | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$45.07 | \$58.79 |
| 8th 6 months | 95.00 | \$28.97 | \$9.27 | \$6.93 | \$0.68 | \$0.00 | \$0.75 | \$0.00 | \$0.00 | \$0.00 | \$46.60 | \$61.08 |

Special Calculation Note :

Ratio :

- 1-2 Journeyman to 1 Apprentice
- 3-4 Journeyman to 2 Apprentice
- 5-6 Journeyman to 2 Apprentice
- 7-10 Journeyman to 3 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

- COSHOCTON, FAIRFIELD, GUERNSEY,
- HOCKING, KNOX, LICKING, MORGAN,
- MUSKINGUM, NOBLE*, PERRY

Mason Trainee Ratio

- 1 Apprentice permits 1 Mason Trainee
- 2 Apprentice permits 1 Mason Trainee
- 3 Apprentice permits 2 Mason Trainee
- 4 Apprentice permits 2 Mason Trainee

Special Jurisdictional Note : In Noble County the following townships are included: (Beaver, Buffalo, Wayne and Seneca)

Details :

BAT registered apprentice must be employed prior to hiring mason trainee (s). A mason trainee MAY NOT work on a jobsite unless a registered apprentice is on the job.

Prevailing Wage Rate Skilled Crafts

Name of Union: Bricklayer Local 55 Tile Setter

Change # : LCN01-2022sksLoc55

Craft : Bricklayer Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-------------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Bricklayer Tile Setter | \$29.09 | | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$45.39 | \$59.93 |
| Marble Mason | \$29.09 | | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$45.39 | \$59.93 |
| Terrazzo Worker | \$29.34 | | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$45.64 | \$60.31 |
| Terrazzo Worker, Installation | \$29.34 | | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$45.64 | \$60.31 |
| Apprentice | | | | | | | | | | | | |
| | Percent | | | | | | | | | | | |
| 1st 6 months | 60.00 | \$17.45 | \$7.80 | \$0.00 | \$0.60 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$25.85 | \$34.58 |
| 2nd 6 months | 65.00 | \$18.91 | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$35.21 | \$44.66 |
| 3rd 6 months | 70.00 | \$20.36 | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$36.66 | \$46.84 |
| 4th 6 months | 75.00 | \$21.82 | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$38.12 | \$49.03 |
| 5th 6 months | 80.00 | \$23.27 | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$39.57 | \$51.21 |
| 6th 6 months | 85.00 | \$24.73 | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$41.03 | \$53.39 |
| 7th 6 months | 90.00 | \$26.18 | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$42.48 | \$55.57 |
| 8th 6 months | 95.00 | \$27.64 | \$7.80 | \$7.40 | \$0.60 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$43.94 | \$57.75 |

Special Calculation Note : Classification title contains "Bricklayer" because contract originates within the Bricklayer Local.

Note that the classification description is clarified after the local union number at the top of the page.

Ratio :

1 - 3 Journeyman to 1 Apprentice
4 - 8 Journeyman to 2 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ATHENS, COSHOCTON, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HOCKING,

9 - 13 Journeyman to 3 Apprentice
14 - 18 Journeyman to 4 Apprentice

JACKSON, KNOX, LICKING, MADISON, MEIGS,
MORGAN, MUSKINGUM, NOBLE, PERRY,
PICKAWAY, PIKE, ROSS, UNION, VINTON,
WASHINGTON

Special Jurisdictional Note : Noble County: (Townships of Beaver, Buffalo, Seneca & Wayne)

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Bricklayer Local 55 Tile & Marble Finisher

Change # : LCN01-2022sksLoc55

Craft : Bricklayer Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---------------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Bricklayer Tile Marble Finisher | \$27.56 | | \$6.38 | \$3.24 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$37.66 | \$51.44 |
| Terrazzo Finisher | \$27.81 | | \$6.38 | \$3.24 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$37.91 | \$51.82 |
| Floor Grinder | \$28.11 | | \$6.38 | \$3.24 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$38.21 | \$52.27 |
| Base Grinder | \$28.31 | | \$6.38 | \$3.24 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$38.41 | \$52.57 |
| Apprentice | | | | | | | | | | | | |
| | Percent | | | | | | | | | | | |
| 1st 6 months | 60.00 | \$16.54 | \$6.38 | \$0.00 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$23.40 | \$31.66 |
| 2nd 6 months | 65.00 | \$17.91 | \$6.38 | \$3.24 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$28.01 | \$36.97 |
| 3rd 6 months | 70.00 | \$19.29 | \$6.38 | \$3.24 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$29.39 | \$39.04 |
| 4th 6 months | 75.00 | \$20.67 | \$6.38 | \$3.24 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$30.77 | \$41.10 |
| 5th 6 months | 80.00 | \$22.05 | \$6.38 | \$3.24 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$32.15 | \$43.17 |
| 6th 6 months | 90.00 | \$24.80 | \$6.38 | \$3.24 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$34.90 | \$47.31 |
| Apprentice Improver | 50.00 | \$13.78 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$13.78 | \$20.67 |

Special Calculation Note : Classification title contains "Bricklayer" because contract originates within the Bricklayer Local.

Note that the classification description is clarified after the local union number at the top of the page.

Ratio :

1-2 Journeyman to 1 Apprentice
3-5 Journeyman to 2 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ATHENS, COSHOCTON, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HOCKING, JACKSON, KNOX, LICKING, MADISON, MEIGS, MORGAN, MUSKINGUM, NOBLE, PERRY,

PICKAWAY, PIKE, ROSS, UNION, VINTON,
WASHINGTON

Special Jurisdictional Note :

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Carpenter Commercial NE Zone 2C

Change # : OCR01-2022sksLocNEZone2C

Craft : Carpenter Effective Date : 06/15/2022 Last Posted : 06/15/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Carpenter | \$29.15 | | \$7.79 | \$10.59 | \$0.50 | \$0.00 | \$2.21 | \$0.12 | \$0.00 | \$0.00 | \$50.36 | \$64.93 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 3 Months | 60.00 | \$17.49 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$17.49 | \$26.23 |
| 2nd 3 Months | 60.00 | \$17.49 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.12 | \$0.00 | \$0.00 | \$25.90 | \$34.64 |
| 2nd 6 Months | 60.00 | \$17.49 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.12 | \$0.00 | \$0.00 | \$25.90 | \$34.64 |
| 3rd 6 Months | 60.00 | \$17.49 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.12 | \$0.00 | \$0.00 | \$25.90 | \$34.64 |
| 4th 6 Months | 60.00 | \$17.49 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.12 | \$0.00 | \$0.00 | \$25.90 | \$34.64 |
| 5th 6 Months | 70.02 | \$20.41 | \$7.79 | \$7.41 | \$0.50 | \$0.00 | \$1.55 | \$0.12 | \$0.00 | \$0.00 | \$37.78 | \$47.99 |
| 6th 6 Months | 75.00 | \$21.86 | \$7.79 | \$7.94 | \$0.50 | \$0.00 | \$1.66 | \$0.12 | \$0.00 | \$0.00 | \$39.87 | \$50.80 |
| 7th 6 Months | 80.00 | \$23.32 | \$7.79 | \$8.47 | \$0.50 | \$0.00 | \$1.77 | \$0.12 | \$0.00 | \$0.00 | \$41.97 | \$53.63 |
| 8th 6 Months | 85.00 | \$24.78 | \$7.79 | \$9.00 | \$0.50 | \$0.00 | \$1.88 | \$0.12 | \$0.00 | \$0.00 | \$44.07 | \$56.46 |

Special Calculation Note : *Other is International training

Ratio :

2 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

COSHOCTON, HOLMES, KNOX, MORROW

Special Jurisdictional Note :

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Carpenter Floorlayer NE Zone 2C

Change # : OCR01-2022sksLocNEZone2C

Craft : Carpenter Effective Date : 06/15/2022 Last Posted : 06/15/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Carpenter Floorlayer | \$29.15 | | \$7.79 | \$10.59 | \$0.50 | \$0.00 | \$2.21 | \$0.14 | \$0.00 | \$0.00 | \$50.38 | \$64.95 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 3 Months | 60.00 | \$17.49 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$17.49 | \$26.23 |
| 2nd 3 Months | 60.00 | \$17.49 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.14 | \$0.00 | \$0.00 | \$25.92 | \$34.67 |
| 2nd 6 Months | 60.00 | \$17.49 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.14 | \$0.00 | \$0.00 | \$25.92 | \$34.67 |
| 3rd 6 Months | 60.00 | \$17.49 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.14 | \$0.00 | \$0.00 | \$25.92 | \$34.67 |
| 4th 6 Months | 60.00 | \$17.49 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.14 | \$0.00 | \$0.00 | \$25.92 | \$34.67 |
| 5th 6 Months | 70.02 | \$20.41 | \$7.79 | \$7.41 | \$0.50 | \$0.00 | \$1.55 | \$0.14 | \$0.00 | \$0.00 | \$37.80 | \$48.01 |
| 6th 6 Months | 75.00 | \$21.86 | \$7.79 | \$7.94 | \$0.50 | \$0.00 | \$1.66 | \$0.14 | \$0.00 | \$0.00 | \$39.89 | \$50.82 |
| 7th 6 Months | 80.00 | \$23.32 | \$7.79 | \$8.47 | \$0.50 | \$0.00 | \$1.77 | \$0.14 | \$0.00 | \$0.00 | \$41.99 | \$53.65 |
| 8th 6 Months | 85.00 | \$24.78 | \$7.79 | \$9.00 | \$0.50 | \$0.00 | \$1.88 | \$0.14 | \$0.00 | \$0.00 | \$44.09 | \$56.48 |

Special Calculation Note : *Other is International Training

Ratio :

2 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

COSHOCTON, HOLMES, KNOX, MORROW

Special Jurisdictional Note :

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Carpenter Insulation NE Zone 2C

Change # : LCN01-2022sksLocNEzone2C

Craft : Carpenter Effective Date : 06/15/2022 Last Posted : 06/15/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|----------------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Carpenter Insulation | \$23.32 | | \$7.79 | \$10.59 | \$0.50 | \$0.00 | \$2.21 | \$0.12 | \$0.00 | \$0.00 | \$44.53 | \$56.19 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 3 months | 50.00 | \$11.66 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$11.66 | \$17.49 |
| 2nd 3 months | 50.00 | \$11.66 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.12 | \$0.00 | \$0.00 | \$20.07 | \$25.90 |
| 2nd 6 months | 50.00 | \$11.66 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.12 | \$0.00 | \$0.00 | \$20.07 | \$25.90 |
| 3rd 6 months | 55.00 | \$12.83 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.12 | \$0.00 | \$0.00 | \$21.24 | \$27.65 |
| 4th 6 months | 60.00 | \$13.99 | \$7.79 | \$0.00 | \$0.50 | \$0.00 | \$0.00 | \$0.12 | \$0.00 | \$0.00 | \$22.40 | \$29.40 |
| 5th 6 months | 70.00 | \$16.32 | \$7.79 | \$7.41 | \$0.50 | \$0.00 | \$1.55 | \$0.12 | \$0.00 | \$0.00 | \$33.69 | \$41.86 |
| 6th 6 months | 75.00 | \$17.49 | \$7.79 | \$7.94 | \$0.50 | \$0.00 | \$1.66 | \$0.12 | \$0.00 | \$0.00 | \$35.50 | \$44.25 |
| 7th 6 months | 80.00 | \$18.66 | \$7.79 | \$8.47 | \$0.50 | \$0.00 | \$1.77 | \$0.12 | \$0.00 | \$0.00 | \$37.31 | \$46.63 |
| 8th 6 months | 85.00 | \$19.82 | \$7.79 | \$9.00 | \$0.50 | \$0.00 | \$1.88 | \$0.12 | \$0.00 | \$0.00 | \$39.11 | \$49.02 |

Special Calculation Note : *Other is Training

Ratio :

2 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

COSHOCTON, HOLMES, KNOX, MORROW

Special Jurisdictional Note :

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Carpenter Millwright NE Zone M2

Change # : OCR02-2022sksLocNEZoneM2

Craft : Carpenter Effective Date : 07/06/2022 Last Posted : 07/06/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---------------------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Carpenter Millwright | \$34.70 | | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$56.15 | \$73.50 |
| Certified Welder | \$35.70 | | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$57.15 | \$75.00 |
| Lay-Out Man Monorail | \$35.95 | | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$57.40 | \$75.37 |
| Apprentice Percent | | | | | | | | | | | | |
| 1st 6 months | 60.00 | \$20.82 | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$42.27 | \$52.68 |
| 2nd 6 months | 60.00 | \$20.82 | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$42.27 | \$52.68 |
| 3rd 6 months | 62.00 | \$21.51 | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$42.96 | \$53.72 |
| 4th 6 months | 65.50 | \$22.73 | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$44.18 | \$55.54 |
| 5th 6 months | 69.00 | \$23.94 | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$45.39 | \$57.36 |
| 6th 6 months | 72.50 | \$25.16 | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$46.61 | \$59.19 |
| 7th 6 months | 76.00 | \$26.37 | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$47.82 | \$61.01 |
| 8th 6 months | 80.00 | \$27.76 | \$7.83 | \$10.98 | \$0.50 | \$0.00 | \$1.97 | \$0.17 | \$0.00 | \$0.00 | \$49.21 | \$63.09 |

Special Calculation Note : Other is Training

Ratio :

2 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

COSHOCTON, HOLMES, KNOX, MORROW

Special Jurisdictional Note :

Details :

The term “Millwright and Machine Erectors” jurisdiction shall mean the unloading, hoisting, rigging, skidding, moving, dismantling, aligning, erecting, assembling, repairing, maintenance and adjusting of all structures,

processing areas either under cover, under ground or elsewhere, required to process material, handle, manufacture or service, be it powered or receiving power manually, by steam, gas, electricity, gasoline, diesel, nuclear, solar, water, air or chemically, and in industries such as and including, which are identified for the purpose of description, but not limited to, the following: woodworking plants; canning industries; steel mills; coffee roasting plants; paper and pulp; cellophane; stone crushing; gravel and sand washing and handling; refineries; grain storage and handling; asphalt plants; sewage disposal; water plants; laundries; bakeries; mixing plants; can, bottle and bag packing plants; textile mills; paint mills; breweries; milk processing plants; power plants; aluminum processing or manufacturing plants; and amusement and entertainment fields. The installation of mechanical equipment in atomic energy plants; installation of reactors in power plants; installation of control rods and equipment in reactors; and installation of mechanical equipment in rocket missile bases, launchers, launching gantry, floating bases, hydraulic escape doors and any and all component parts thereto, either assembled, semi-assembled or disassembled. The installation of, but not limited to, the following: setting-up of all engines, motors, generators, air compressors, fans, pumps, scales, hoppers, conveyors of all types, sizes and their supports; escalators; man lifts; moving sidewalks; hoists; dumb waiters; all types of feeding machinery; amusement devices; mechanical pin setters and spotters in bowling alleys; refrigeration equipment; and the installation of all types of equipment necessary and required to process material either in the manufacturing or servicing. The handling and installation of pulleys, gears, sheaves, fly wheels, air and vacuum drives, worm drives and gear drives directly or indirectly coupled to motors, belts, chains, screws, legs, boots, guards, booth tanks, all bin valves, turn heads and indicators, shafting, bearings, cable sprockets, cutting all key seats in new and old work, troughs, chippers, filters, calendars, rolls, winders, rewinders, slitters, cutters, wrapping machines, blowers, forging machines, rams, hydraulic or otherwise, planing, extruder, ball, dust collectors, equipment in meat packing plants, splicing of ropes and cables. The laying-out, fabrication and installation of protection equipment including machinery guards, making and setting of templates for machinery, fabrication of bolts, nuts, pans, drilling of holes for any equipment which the Millwrights install regardless of materials; all welding and burning regardless of type, fabrication of all lines, hose or tubing used in lubricating machinery installed by Millwrights; grinding, cleaning, servicing and any machine work necessary for any part of any equipment installed by the Millwrights; and the break-in and trial run of any equipment or machinery installed by the Millwrights. It is agreed the Millwrights shall use the layout tools and optic equipment necessary to perform their work.

Prevailing Wage Rate Skilled Crafts

Name of Union: Carpenter NE District Industrial Dock & Door

Change # : LCN01-2014fbCarpNEStatewide

Craft : Carpenter Effective Date : 03/05/2014 Last Posted : 03/05/2014

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Carpenter | \$19.70 | | \$5.05 | \$1.00 | \$0.15 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$25.90 | \$35.75 |
| Trainee | Percent | | | | | | | | | | | |
| 1st Year | 60.00 | \$11.82 | \$5.05 | \$1.00 | \$0.15 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$18.02 | \$23.93 |
| 2nd Year | 80.20 | \$15.80 | \$5.05 | \$1.00 | \$0.15 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$22.00 | \$29.90 |

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeymen to 1 Trainee

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note : Industrial Dock and Door is the installation of overhead doors, roll up doors and dock leveling equipment

Details :

10/27/10 New Contract jc

Prevailing Wage Rate Skilled Crafts

Name of Union: Carpenter Pile Driver NE Zone P2

Change # : OCR01-2022sksLocNEZoneP2

Craft : Carpenter Effective Date : 06/15/2022 Last Posted : 06/15/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---------------------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Carpenter Pile Driver | \$30.27 | | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$51.99 | \$67.13 |
| Diver | \$45.41 | | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$67.13 | \$89.84 |
| Certified Welder | \$31.32 | | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$53.04 | \$68.70 |
| Apprentice Percent | | | | | | | | | | | | |
| 1st 6 months | 60.00 | \$18.16 | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$39.88 | \$48.96 |
| 2nd 6 months | 60.00 | \$18.16 | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$39.88 | \$48.96 |
| 3rd 6 months | 62.00 | \$18.77 | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$40.49 | \$49.87 |
| 4th 6 months | 65.50 | \$19.83 | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$41.55 | \$51.46 |
| 5th 6 months | 69.00 | \$20.89 | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$42.61 | \$53.05 |
| 6th 6 months | 72.50 | \$21.95 | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$43.67 | \$54.64 |
| 7th 6 months | 76.00 | \$23.01 | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$44.73 | \$56.23 |
| 8th 6 months | 80.00 | \$24.22 | \$8.23 | \$10.98 | \$0.50 | \$0.00 | \$1.84 | \$0.17 | \$0.00 | \$0.00 | \$45.94 | \$58.04 |

Special Calculation Note : *Other is Training

Ratio :

2 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

COSHOCTON, HOLMES, KNOX, MORROW

Special Jurisdictional Note :

Details :

Pile Drivers duties shall include but not limited to: Pile driving, milling, fashioning, joining assembling, erecting, fastening, or dismantling of all material of wood, plastic, metal, fiber, cork and composition and all other substitute materials: pile driving, cutting, fitting and placing of lagging, and the handling, cleaning,

erecting, installing and dismantling of machinery, equipment and erecting pre-engineered metal buildings. Pile Drivers work but not limited to: unloading, assembling, erection, repairs, operation, signaling, dismantling and reloading all equipment that is used for pile driving including pile butts is defined as sheeting or scrap piling. Underwater work that may be required in connection with the installation of piling. The driver and his tender work as a team and shall arrive at their own financial arrangements with the contractor. Any configuration of wood, steel, concrete or composite that is jetted, driven or vibrated onto the ground by conventional pile driving equipment for the purpose of supporting a future load that may be permanent or temporary. The construction of all wharves and docks, including the fabrication and installation of floating docks. Driving bracing, plumbing, cutting off and capping of all piling whether wood, metal, pipe piling or composite, loading, unloading, erecting, framing, dismantling, moving and handling of pile driving equipment piling used in the construction and repair of all wharves, docks, piers, trestles, caissons, cofferdams and erection of all sea walls and breakwaters. All underwater and marine work on bulkheads, wharves, docks, shipyards, caissons, piers, bridges, pipeline, work, viaducts, marine cable and trestles, as well as salvage and reclamation work where divers are employed. Rate shall include carpenters, acoustic and ceiling installers, drywall installers, pile drivers and floorlayers.

Prevailing Wage Rate Skilled Crafts

Name of Union: Cement Mason Bricklayer Local 97 HevHwy A

Change # : LCN01-2022sksHvyHwy

Craft : Bricklayer Effective Date : 06/08/2022 Last Posted : 06/08/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|---------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | | |
| Cement Mason Bricklayer Sewer Water Works A | \$31.40 | | \$9.75 | \$8.30 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$49.95 | \$65.65 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st year | 70.00 | \$21.98 | \$9.75 | \$8.30 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$40.53 | \$51.52 |
| 2nd year | 80.00 | \$25.12 | \$9.75 | \$8.30 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$43.67 | \$56.23 |
| 3rd year | 90.00 | \$28.26 | \$9.75 | \$8.30 | \$0.50 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$46.81 | \$60.94 |

Special Calculation Note : NOT FOR BUILDING CONSTRUCTION.

Ratio :

- 3 Journeymen to 1 Apprentice
- 6 Journeymen to 2 Apprentice
- 9 Journeymen to 3 Apprentice
- 12 Journeymen to 4 Apprentice
- 15 Journeymen to 5 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

- ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

(A) Highway Construction, Sewer, Waterworks And Utility Construction, Industrial & Building Site Heavy Construction, Airport Construction Or Railroad Construction Work.

(B) Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work ,Pollution Control,Sewer Plant, Waste Plant, & Water Treatment Facilities, Construction.

Prevailing Wage Rate Skilled Crafts

Name of Union: Cement Mason Bricklayer Local 97 HevHwy B

Change # : LCN01-2022sksHvyHwy

Craft : Bricklayer Effective Date : 06/08/2022 Last Posted : 06/08/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|--|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Cement Mason Bricklayer Power Plants Tunnels Amusement Parks B | \$32.39 | | \$9.75 | \$8.30 | \$0.51 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$50.95 | \$67.15 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st year | 70.00 | \$22.67 | \$9.75 | \$8.30 | \$0.51 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$41.23 | \$52.57 |
| 2nd year | 80.00 | \$25.91 | \$9.75 | \$8.30 | \$0.51 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$44.47 | \$57.43 |
| 3rd year | 90.00 | \$29.15 | \$9.75 | \$8.30 | \$0.51 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$47.71 | \$62.29 |

Special Calculation Note : NOT FOR BUILDING CONSTRUCTION.

Ratio :

- 3 Journeymen to 1 Apprentice
- 6 Journeymen to 2 Apprentice
- 9 Journeymen to 2 Apprentice
- 12 Journeymen to 4 Apprentice
- 15 Journeymen to 5 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

- ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEauga, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, SUMMIT,

TRUMBULL, TUSCARAWAS, UNION, VAN WERT,
VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

(A) Highway Construction, Sewer, Waterworks And Utility Construction, Industrial & Building Site Heavy Construction, Airport Construction Or Railroad Construction Work.

(B) Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work ,Pollution Control,Sewer Plant, Waste Plant, & Water Treatment Facilities, Construction.

Prevailing Wage Rate Skilled Crafts

Name of Union: Cement Mason Local 132 (Columbus)

Change # : LCN01-2022sksLoc132

Craft : Cement Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Cement Mason | \$30.03 | | \$7.80 | \$4.55 | \$0.65 | \$0.00 | \$2.25 | \$0.05 | \$0.00 | \$0.00 | \$45.33 | \$60.34 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st yr | 70.00 | \$21.02 | \$7.80 | \$4.55 | \$0.65 | \$0.00 | \$2.25 | \$0.05 | \$0.00 | \$0.00 | \$36.32 | \$46.83 |
| 2nd yr | 80.00 | \$24.02 | \$7.80 | \$4.55 | \$0.65 | \$0.00 | \$2.25 | \$0.05 | \$0.00 | \$0.00 | \$39.32 | \$51.34 |
| 3rd yr | 90.00 | \$27.03 | \$7.80 | \$4.55 | \$0.65 | \$0.00 | \$2.25 | \$0.05 | \$0.00 | \$0.00 | \$42.33 | \$55.84 |

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time. *Other is International Training.

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, COSHOCTON, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HOCKING, KNOX, LICKING, MADISON, MARION, MORROW, MUSKINGUM, PERRY, PICKAWAY, RICHLAND, ROSS, UNION, VINTON, WYANDOT

Special Jurisdictional Note :

Details :

Working on swing stage, slip scaffold or window jack scaffold shall receive the following rates:
 \$.50 above the regular rate for heights up to fifty (50) feet above grade level
 \$1.00 above the regular rate for heights over fifty (50) feet above grade level

Prevailing Wage Rate Skilled Crafts

Name of Union: Cement Mason Statewide HevHwy

Change # : OCR01-2022sksCementHevHwy

Craft : Cement Mason Effective Date : 05/05/2022 Last Posted : 05/05/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Cement Mason | \$32.49 | | \$8.45 | \$7.35 | \$0.65 | \$0.00 | \$2.25 | \$0.07 | \$0.00 | \$0.00 | \$51.26 | \$67.50 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st Year | 70.00 | \$22.74 | \$8.45 | \$7.35 | \$0.65 | \$0.00 | \$2.25 | \$0.07 | \$0.00 | \$0.00 | \$41.51 | \$52.88 |
| 2nd Year | 80.00 | \$25.99 | \$8.45 | \$7.35 | \$0.65 | \$0.00 | \$2.25 | \$0.07 | \$0.00 | \$0.00 | \$44.76 | \$57.76 |
| 3rd Year | 90.00 | \$29.24 | \$8.45 | \$7.35 | \$0.65 | \$0.00 | \$2.25 | \$0.07 | \$0.00 | \$0.00 | \$48.01 | \$62.63 |

Special Calculation Note : Other \$0.07 is for International Training Fund

Ratio :

1 Journeymen to 1 Apprentice
2 to 1 thereafter

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA*,
ATHENS, AUGLAIZE, BELMONT, BROWN,
BUTLER, CARROLL, CHAMPAIGN, CLARK,
CLERMONT, CLINTON, COLUMBIANA,
COSHOCOTON, CRAWFORD, CUYAHOGA*,
DARKE, DEFIANCE, DELAWARE, ERIE,
FAIRFIELD, FAYETTE, FRANKLIN, FULTON*,
GALLIA, GEAUGA*, GREENE, GUERNSEY,
HAMILTON, HANCOCK*, HARDIN, HARRISON,
HENRY*, HIGHLAND, HOCKING, HOLMES,
HURON, JACKSON, JEFFERSON, KNOX, LAKE*,
LAWRENCE, LICKING, LOGAN, LORAIN,
LUCAS*, MADISON, MAHONING, MARION,
MEDINA, MEIGS, MERCER, MIAMI, MONROE,
MONTGOMERY, MORGAN, MORROW,
MUSKINGUM, NOBLE, OTTAWA, PAULDING,
PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE,
PUTNAM*, RICHLAND, ROSS, SANDUSKY,
SCIOTO, SENECA, SHELBY, STARK, SUMMIT,
TRUMBULL, TUSCARAWAS, UNION, VAN WERT,
VINTON, WARREN, WASHINGTON, WAYNE,
WILLIAMS, WOOD*, WYANDOT

Special Jurisdictional Note : (A) Highway Construction, Sewer, Waterworks And Utility Construction, Industrial & Building Site, Heavy

Construction, Airport Construction Or Railroad Construction Work, Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work, Pollution Control, Sewer Plant, Waste & Water Plant, Water Treatment Facilities Construction.

*For Power Plant, Tunnels, Amusement Park, Athletic Stadium Site Work, Pollution Control, Sewer Plant, Waste & Water Plant, Water Treatment Facility Construction work in the following Counties: Ashtabula, Cuyahoga, Fulton, Geauga, Hancock, Henry, Lake, Lucas, Putnam and Wood Counties, those counties will use the Cement Mason Statewide Heavy Highway Exhibit B District 1 Wage Rate.

Details :

This rate replaces the previous Cement Mason Heavy Highway Statewide Rates (Exhibit A and Exhibit B rates), except for Cement Mason Statewide Heavy Highway Exhibit B Dist 1. sks

Prevailing Wage Rate Skilled Crafts

Name of Union: **Electrical Local 1105 Inside**

Change # : LCN01-2022sksLoc1105

Craft : Electrical Effective Date : 06/29/2022 Last Posted : 06/29/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|--------------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Electrician | \$35.25 | | \$10.20 | \$8.08 | \$0.65 | \$0.00 | \$3.85 | \$0.00 | \$0.00 | \$0.00 | \$58.03 | \$75.65 |
| Over 50 Feet | \$44.06 | | \$10.20 | \$8.34 | \$0.65 | \$0.00 | \$3.85 | \$0.00 | \$0.00 | \$0.00 | \$67.10 | \$89.13 |
| Over 100 feet | \$52.88 | | \$10.20 | \$8.61 | \$0.65 | \$0.00 | \$3.85 | \$0.00 | \$0.00 | \$0.00 | \$76.19 | \$102.63 |
| 1st period CW 0-2000 hours | \$12.76 | | \$6.47 | \$0.38 | \$0.72 | \$0.00 | \$0.38 | \$0.00 | \$0.00 | \$0.00 | \$20.71 | \$27.09 |
| 2nd period CW 2001-4000 hours | \$13.61 | | \$6.47 | \$0.41 | \$0.72 | \$0.00 | \$0.41 | \$0.00 | \$0.00 | \$0.00 | \$21.62 | \$28.42 |
| 3rd period CW 4001-6000 hours | \$14.46 | | \$6.47 | \$0.43 | \$0.72 | \$0.00 | \$0.43 | \$0.00 | \$0.00 | \$0.00 | \$22.51 | \$29.74 |
| 4th period CW 6001-8000 hours | \$16.16 | | \$6.47 | \$0.48 | \$0.72 | \$0.00 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$24.31 | \$32.39 |
| 1st Level CE 8001-10000 hours | \$17.86 | | \$6.47 | \$0.54 | \$0.72 | \$0.00 | \$0.54 | \$0.00 | \$0.00 | \$0.00 | \$26.13 | \$35.06 |
| 2nd Level CE 10001-12000 hours | \$19.56 | | \$6.47 | \$0.59 | \$0.72 | \$0.00 | \$0.59 | \$0.00 | \$0.00 | \$0.00 | \$27.93 | \$37.71 |
| 3rd Level CE 12001-14000 hours | \$24.66 | | \$6.47 | \$0.74 | \$0.72 | \$0.00 | \$0.74 | \$0.00 | \$0.00 | \$0.00 | \$33.33 | \$45.66 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st period 0-1000 | 40.00 | \$14.10 | \$10.20 | \$0.42 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$27.32 | \$34.37 |
| 2nd period 1001-2000 | 45.00 | \$15.86 | \$10.20 | \$0.48 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$29.14 | \$37.07 |

| | | | | | | | | | | | | |
|-------------------------|-------|---------|---------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| 3rd period 2001-3500 | 55.00 | \$19.39 | \$10.20 | \$4.44 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$36.63 | \$46.32 |
| 4th period 3501-5000 | 65.00 | \$22.91 | \$10.20 | \$5.25 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$40.96 | \$52.42 |
| 5th period 5001-6500 | 70.02 | \$24.68 | \$10.20 | \$5.65 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$43.13 | \$55.47 |
| 6th period 6501-8000 | 80.00 | \$28.20 | \$10.20 | \$6.47 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$47.47 | \$61.57 |

Special Calculation Note : On ALL other jobs sites, CW/CE's CAN only be employed after an APPRENTICE IS EMPLOYED on the job site.

Ratio :

1 to 3 Journeymen to 2 Apprentices
4 to 6 Journeymen to 4 Apprentices

Jurisdiction (* denotes special jurisdictional note) :

COSHOCTON, GUERNSEY, KNOX*, LICKING,
MUSKINGUM, PERRY, TUSCARAWAS*

Special Jurisdictional Note : In Knox County the following townships: Butler, Clay, College, Harrison, Hilliard, Jackson, Milford, Miller, Morgan and Pleasant. In Tuscarawas County the following townships: Auburn, Bucks, Clay, Jefferson, Oxford, Perry, Rush, Salem, Washington and York

Details :

The Construction Wireman/Construction Electrician Classifications are applicable to all work except industrial facilities, manufacturing facilities, colleges and universities within the geographical jurisdiction of Local Union No. 1105.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 1105 Inside Lt Commercial South West

Change # : LCN01-2022sksLoc1105

Craft : Electrical Effective Date : 06/29/2022 Last Posted : 06/29/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Electrician | \$35.25 | | \$10.20 | \$8.08 | \$0.65 | \$0.00 | \$3.85 | \$0.00 | \$0.00 | \$0.00 | \$58.03 | \$75.65 |
| 50 - 100 feet | \$44.06 | | \$10.20 | \$8.34 | \$0.65 | \$0.00 | \$3.85 | \$0.00 | \$0.00 | \$0.00 | \$67.10 | \$89.13 |
| Over 100 feet | \$52.88 | | \$10.20 | \$8.61 | \$0.65 | \$0.00 | \$3.85 | \$0.00 | \$0.00 | \$0.00 | \$76.19 | \$102.63 |
| CE-3 12,001-14,000 Hrs | \$24.66 | | \$6.47 | \$0.74 | \$0.72 | \$0.00 | \$0.74 | \$0.00 | \$0.00 | \$0.00 | \$33.33 | \$45.66 |
| CE-2 10,001-12,000 Hrs | \$19.56 | | \$6.47 | \$0.59 | \$0.72 | \$0.00 | \$0.59 | \$0.00 | \$0.00 | \$0.00 | \$27.93 | \$37.71 |
| CE-1 8,001-10,000 Hrs | \$17.86 | | \$6.47 | \$0.54 | \$0.72 | \$0.00 | \$0.54 | \$0.00 | \$0.00 | \$0.00 | \$26.13 | \$35.06 |
| CW-4 6,001-8,000 Hrs | \$16.16 | | \$6.47 | \$0.48 | \$0.72 | \$0.00 | \$0.48 | \$0.00 | \$0.00 | \$0.00 | \$24.31 | \$32.39 |
| CW-3 4,001-6,000 Hrs | \$14.46 | | \$6.47 | \$0.43 | \$0.72 | \$0.00 | \$0.43 | \$0.00 | \$0.00 | \$0.00 | \$22.51 | \$29.74 |
| CW-2 2,001-4,000 Hrs | \$13.61 | | \$6.47 | \$0.41 | \$0.72 | \$0.00 | \$0.41 | \$0.00 | \$0.00 | \$0.00 | \$21.62 | \$28.42 |
| CW-1 0-2,000 Hrs | \$12.76 | | \$6.47 | \$0.38 | \$0.72 | \$0.00 | \$0.38 | \$0.00 | \$0.00 | \$0.00 | \$20.71 | \$27.09 |
| Apprentice Indentured AFTER January 1, 2005) | Percent | | | | | | | | | | | |
| 1st period 0-1000 hours | 40.00 | \$14.10 | \$10.20 | \$0.42 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$27.32 | \$34.37 |
| 2nd period 1001-2000 hours | 45.00 | \$15.86 | \$10.20 | \$0.48 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$29.14 | \$37.07 |

| | | | | | | | | | | | | |
|-----------------------------------|-------|---------|---------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| 3rd period 2001- 3500 hours | 55.00 | \$19.39 | \$10.20 | \$4.44 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$36.63 | \$46.32 |
| 4th period 3501- 5000 hours | 65.00 | \$22.91 | \$10.20 | \$5.25 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$40.96 | \$52.42 |
| 5th period 5001- 6500 hours | 70.00 | \$24.67 | \$10.20 | \$5.65 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$43.13 | \$55.46 |
| 6th period 6501- 8000 hours | 80.00 | \$28.20 | \$10.20 | \$6.47 | \$0.65 | \$0.00 | \$1.95 | \$0.00 | \$0.00 | \$0.00 | \$47.47 | \$61.57 |

Special Calculation Note : On ALL other job sites, CW/CE's CAN only be employed after an APPRENTICE IS EMPLOYED on the job site.

Ratio :

1-3 Journeyman to 2 Apprentices
4-6 Journeyman to 4 Apprentices

Jurisdiction (* denotes special jurisdictional note) :

COSHOCTON, GUERNSEY, KNOX*, LICKING, MUSKINGUM, PERRY, TUSCARAWAS*

Construction Electrician and Construction Wireman Ratio

There shall be a minimum ratio of one inside Journeyman to every (4) employees of different classification per jobsite. An inside Journeyman Wireman is required on the project as the fifth (5th) worker or when apprentices are used.

Special Jurisdictional Note : In Knox County the following townships: Butler, Clay, College, Harrison, Hilliard, Jackson, Milford, Miller, Morgan and Pleasant. In Tuscarawas County the following townships: Auburn, Bucks, Clay, Jefferson, Oxford, Perry, Rush, Salem, Washington and York

The scope of work for the light commercial agreement shall apply to the following facilities not to exceed 200,000 square feet; office buildings, shopping centers, auto sales agencies and garages, churches, funeral homes, nursing homes, hotels, retail and wholesale facilities, small stand-alone manufacturing facilities when free standing and not part of a larger facility (not to exceed 50,000 square fee), solar projects (500 panels or less) unless otherwise covered under the agreement, lighting retrofits (when not associated with remodels involving branch re-circuiting) lighting retrofits shall be defined as the changing of lamps and ballasts in existing light fixtures and shall also include the one for one replacement of existing fixtures, warehouses, gas stations, food service centers, restaurants, entertainment facilities, hospitals, clinics, motels, residential buildings.

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 1105 Voice Data Video

Change # : LCN01-2022sksLoc1105VDV

Craft : Voice Data Video Effective Date : 06/29/2022 Last Posted : 06/29/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------------------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Electrical Installer Technician B | \$29.29 | | \$10.20 | \$1.88 | \$0.70 | \$0.00 | \$0.95 | \$0.68 | \$0.00 | \$0.00 | \$43.70 | \$58.35 |
| Installer Technician A | \$30.54 | | \$10.20 | \$1.92 | \$0.70 | \$0.00 | \$0.95 | \$0.71 | \$0.00 | \$0.00 | \$45.02 | \$60.29 |
| Cable Puller | \$14.65 | | \$10.20 | \$0.44 | \$0.70 | \$0.00 | \$0.95 | \$0.34 | \$0.00 | \$0.00 | \$27.28 | \$34.61 |
| Apprentices | Percent | | | | | | | | | | | |
| 1st Period 0-1000hrs | 55.00 | \$16.11 | \$10.20 | \$1.48 | \$0.70 | \$0.00 | \$0.95 | \$0.37 | \$0.00 | \$0.00 | \$29.81 | \$37.86 |
| 2nd Period 1001-2000hrs | 60.00 | \$17.57 | \$10.20 | \$1.53 | \$0.70 | \$0.00 | \$0.95 | \$0.41 | \$0.00 | \$0.00 | \$31.36 | \$40.15 |
| 3rd Period 2001-3000hr | 65.00 | \$19.04 | \$10.20 | \$1.57 | \$0.70 | \$0.00 | \$0.95 | \$0.44 | \$0.00 | \$0.00 | \$32.90 | \$42.42 |
| 4th Period 3001-4000hrs | 70.00 | \$20.50 | \$10.20 | \$1.62 | \$0.70 | \$0.00 | \$0.95 | \$0.47 | \$0.00 | \$0.00 | \$34.44 | \$44.69 |
| 5th Period 4001-5000hrs | 75.00 | \$21.97 | \$10.20 | \$1.66 | \$0.70 | \$0.00 | \$0.95 | \$0.51 | \$0.00 | \$0.00 | \$35.99 | \$46.97 |
| 6th Period 5001-6000hrs | 80.00 | \$23.43 | \$10.20 | \$1.70 | \$0.70 | \$0.00 | \$0.95 | \$0.54 | \$0.00 | \$0.00 | \$37.52 | \$49.24 |

Special Calculation Note : Other is for Holiday Pay. Vacation: Only applies to employees with one (1) continuous year of service with a firm.

Ratio :

1 Journeyman Installer to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

COSHOCTON, GUERNSEY, KNOX*, LICKING, MUSKINGUM, PERRY, TUSCARAWAS*

Special Jurisdictional Note : In Knox County: the following townships:Butler, Clay, College, Harrison,

Hilliar, Jackson, Milford, Miller, Morgan, Pleasant

In Tuscarawas County: the following townships: Auburn, Bucks, Clay, Jefferson, Oxford, Perry, Rush, Salem, Washington and York

Details :

An employee who is required to wear an electronic device after hours will receive an additional 1.00 per hour for all hours worked.

Holidays: Memorial Day - Fourth of July - Labor Day - Thanksgiving Day - Christmas Day - New Years Day

The following work is excluded from the Teledata Technician work scope:

The installation of computer systems in industrial applications such as assembly lines, robotics, computer controller manufacturing systems.

The installation of conduit and/ or raceways shall be installed by Inside Wireman . On sites where there is no Inside Wireman employed, the Teledata Technician may install raceway, or conduit not greater than 10 ft.

Fire Alarm work is excluded on all new construction sites or wherever the fire alarm system is installed in conduit

All HVAC control work.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 71 High Tension Pipe Type Cable

Change # : LCN01-2021fbLoc7

Craft : Lineman Effective Date : 03/16/2021 Last Posted : 03/16/2021

| | BHR | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|---------------------------------|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | |
| Electrical Lineman | \$45.61 | \$6.75 | \$1.37 | \$0.46 | \$0.00 | \$10.95 | \$0.60 | \$0.00 | \$0.00 | \$65.74 | \$88.54 |
| Certified Lineman Welder | \$45.61 | \$6.75 | \$1.37 | \$0.46 | \$0.00 | \$10.95 | \$0.60 | \$0.00 | \$0.00 | \$65.74 | \$88.54 |
| Certified Cable Splicer | \$45.61 | \$6.75 | \$1.37 | \$0.46 | \$0.00 | \$10.95 | \$0.60 | \$0.00 | \$0.00 | \$65.74 | \$88.54 |
| Operator A | \$40.88 | \$6.75 | \$1.23 | \$0.41 | \$0.00 | \$9.81 | \$0.60 | \$0.00 | \$0.00 | \$59.68 | \$80.12 |
| Operator B | \$36.20 | \$6.75 | \$1.09 | \$0.36 | \$0.00 | \$8.69 | \$0.60 | \$0.00 | \$0.00 | \$53.69 | \$71.79 |
| Operator C | \$29.12 | \$6.75 | \$0.87 | \$0.29 | \$0.00 | \$6.99 | \$0.60 | \$0.00 | \$0.00 | \$44.62 | \$59.18 |
| Groundman 0-12 months Exp | \$22.81 | \$6.75 | \$0.68 | \$0.23 | \$0.00 | \$5.47 | \$0.60 | \$0.00 | \$0.00 | \$36.54 | \$47.94 |
| Groundman 0-12 months Exp w/CDL | \$25.09 | \$6.75 | \$0.75 | \$0.25 | \$0.00 | \$6.02 | \$0.60 | \$0.00 | \$0.00 | \$39.46 | \$52.01 |
| Groundman 1 yr or more | \$25.09 | \$6.75 | \$0.75 | \$0.25 | \$0.00 | \$6.02 | \$0.60 | \$0.00 | \$0.00 | \$39.46 | \$52.01 |
| Groundman 1 yr or more w/CDL | \$29.65 | \$6.75 | \$0.85 | \$0.28 | \$0.00 | \$6.50 | \$0.60 | \$0.00 | \$0.00 | \$44.63 | \$59.46 |
| Equipment Mechanic A | \$36.20 | \$6.75 | \$1.09 | \$0.36 | \$0.00 | \$8.69 | \$0.60 | \$0.00 | \$0.00 | \$53.69 | \$71.79 |
| Equipment Mechanic B | \$32.66 | \$6.75 | \$0.98 | \$0.33 | \$0.00 | \$7.84 | \$0.60 | \$0.00 | \$0.00 | \$49.16 | \$65.49 |
| Equipment Mechanic C | \$29.12 | \$6.75 | \$0.87 | \$0.29 | \$0.00 | \$6.99 | \$0.60 | \$0.00 | \$0.00 | \$44.62 | \$59.18 |

| | | | | | | | | | | | | |
|-------------------|----------------|---------|--------|--------|--------|---------|--------|--------|--------|---------|---------|---------|
| X-Ray Technician | \$45.61 | \$6.75 | \$1.37 | \$0.46 | \$0.00 | \$10.95 | \$0.60 | \$0.00 | \$0.00 | \$65.74 | \$88.54 | |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 1000 hrs | 60.00 | \$27.37 | \$6.75 | \$0.82 | \$0.27 | \$0.00 | \$6.57 | \$0.60 | \$0.00 | \$0.00 | \$42.38 | \$56.06 |
| 2nd 1000 hrs | 65.00 | \$29.65 | \$6.75 | \$0.89 | \$0.30 | \$0.00 | \$7.12 | \$0.60 | \$0.00 | \$0.00 | \$45.31 | \$60.13 |
| 3rd 1000 hrs | 70.00 | \$31.93 | \$6.75 | \$0.96 | \$0.32 | \$0.00 | \$7.66 | \$0.60 | \$0.00 | \$0.00 | \$48.22 | \$64.18 |
| 4th 1000 hrs | 75.00 | \$34.21 | \$6.75 | \$1.03 | \$0.34 | \$0.00 | \$8.21 | \$0.60 | \$0.00 | \$0.00 | \$51.14 | \$68.24 |
| 5th 1000 hrs | 80.00 | \$36.49 | \$6.75 | \$1.09 | \$0.36 | \$0.00 | \$8.76 | \$0.60 | \$0.00 | \$0.00 | \$54.05 | \$72.29 |
| 6th 1000 hrs | 85.00 | \$38.77 | \$6.75 | \$1.16 | \$0.39 | \$0.00 | \$9.30 | \$0.60 | \$0.00 | \$0.00 | \$56.97 | \$76.35 |
| 7th 1000 hrs | 90.00 | \$41.05 | \$6.75 | \$1.23 | \$0.41 | \$0.00 | \$9.85 | \$0.60 | \$0.00 | \$0.00 | \$59.89 | \$80.41 |

Special Calculation Note : Other is Health Retirement Account

Operator "A"

John Henry Rock Drill, D-6 (or equivalent) and above, Trackhoe Digger, (320 Track excavator), Cranes (greater then 25 tons and less than 45 tons).

Operator "B"

Cranes (greater than 6 tons and up to 25 tons), Backhoes, Road Tractor, Dozer up to D-5, Pressure Digger- wheeled or tracked, all Tension wire Stringing equipment.

Operator "C"

Trench, Backhoe, Riding type vibratory Compactor, Ground Rod Driver, Boom Truck (6 ton & below), Skid Steer Loaders, Material Handler.

*All Operators of cranes 45 ton or larger shall be paid the journeyman rate of pay. \$0.30 is for Health Retirement Account.

Ratio :

1 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, RICHLAND, ROSS, SCIOTO,

SHELBY, STARK, SUMMIT, TRUMBULL,
TUSCARAWAS, UNION, VINTON, WARREN,
WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

Heli - Arc Welding will be paid \$.30 above Journeyman rate. Additional compensation of 10% over the Journeyman Lineman and Journeyman Technician for performing work on structures outside of buildings such as water towers, smoke stacks, radio and television towers, more than 75' above the ground.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 71 Outside Utility Power

Change # : LCN01-2021fbLoc7

Craft : Lineman Effective Date : 03/16/2021 Last Posted : 03/16/2021

| | BHR | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|---------------------------------|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | |
| Electrical Lineman | \$43.22 | \$6.75 | \$1.30 | \$0.43 | \$0.00 | \$10.37 | \$0.60 | \$0.00 | \$0.00 | \$62.67 | \$84.28 |
| Substation Technician | \$43.22 | \$6.75 | \$1.30 | \$0.43 | \$0.00 | \$10.37 | \$0.60 | \$0.00 | \$0.00 | \$62.67 | \$84.28 |
| Cable Splicer | \$45.26 | \$6.75 | \$1.36 | \$0.45 | \$0.00 | \$10.86 | \$0.60 | \$0.00 | \$0.00 | \$65.28 | \$87.91 |
| Operator A | \$38.75 | \$6.75 | \$1.16 | \$0.39 | \$0.00 | \$9.30 | \$0.60 | \$0.00 | \$0.00 | \$56.95 | \$76.32 |
| Operator B | \$34.27 | \$6.75 | \$1.03 | \$0.34 | \$0.00 | \$8.22 | \$0.60 | \$0.00 | \$0.00 | \$51.21 | \$68.34 |
| Operator C | \$27.54 | \$6.75 | \$0.83 | \$0.28 | \$0.00 | \$6.61 | \$0.60 | \$0.00 | \$0.00 | \$42.61 | \$56.38 |
| Groundman 0-12 months Exp | \$21.61 | \$6.75 | \$0.65 | \$0.22 | \$0.00 | \$5.19 | \$0.60 | \$0.00 | \$0.00 | \$35.02 | \$45.82 |
| Groundman 0-12 months Exp w/CDL | \$23.77 | \$6.75 | \$0.71 | \$0.24 | \$0.00 | \$5.70 | \$0.60 | \$0.00 | \$0.00 | \$37.77 | \$49.66 |
| Groundman 1 yr or more | \$23.77 | \$6.75 | \$0.71 | \$0.24 | \$0.00 | \$5.70 | \$0.60 | \$0.00 | \$0.00 | \$37.77 | \$49.66 |
| Groundman 1 yr or more w/CDL | \$28.09 | \$6.75 | \$0.84 | \$0.28 | \$0.00 | \$6.74 | \$0.60 | \$0.00 | \$0.00 | \$43.30 | \$57.35 |
| Equipment Mechanic A | \$34.27 | \$6.75 | \$1.03 | \$0.34 | \$0.00 | \$8.22 | \$0.60 | \$0.00 | \$0.00 | \$51.21 | \$68.34 |
| Equipment Mechanic B | \$30.91 | \$6.75 | \$0.93 | \$0.31 | \$0.00 | \$7.42 | \$0.60 | \$0.00 | \$0.00 | \$46.92 | \$62.38 |
| Equipment Mechanic C | \$27.54 | \$6.75 | \$0.83 | \$0.28 | \$0.00 | \$6.61 | \$0.60 | \$0.00 | \$0.00 | \$42.61 | \$56.38 |
| Line Truck w/uuger | \$30.44 | \$6.75 | \$0.91 | \$0.30 | \$0.00 | \$7.31 | \$0.60 | \$0.00 | \$0.00 | \$46.31 | \$61.53 |

| Apprentice | Percent | | | | | | | | | | | |
|--------------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| 1st 1000 hrs | 60.00 | \$25.93 | \$6.75 | \$0.78 | \$0.26 | \$0.00 | \$6.22 | \$0.60 | \$0.00 | \$0.00 | \$40.54 | \$53.51 |
| 2nd 1000 hrs | 65.00 | \$28.09 | \$6.75 | \$0.84 | \$0.28 | \$0.00 | \$6.74 | \$0.60 | \$0.00 | \$0.00 | \$43.30 | \$57.35 |
| 3rd 1000 hrs | 70.00 | \$30.25 | \$6.75 | \$0.91 | \$0.30 | \$0.00 | \$7.26 | \$0.60 | \$0.00 | \$0.00 | \$46.07 | \$61.20 |
| 4th 1000 hrs | 75.00 | \$32.42 | \$6.75 | \$0.97 | \$0.32 | \$0.00 | \$7.78 | \$0.60 | \$0.00 | \$0.00 | \$48.84 | \$65.04 |
| 5th 1000 hrs | 80.00 | \$34.58 | \$6.75 | \$1.04 | \$0.35 | \$0.00 | \$8.30 | \$0.60 | \$0.00 | \$0.00 | \$51.62 | \$68.90 |
| 6th 1000 hrs | 85.00 | \$36.74 | \$6.75 | \$1.10 | \$0.37 | \$0.00 | \$8.82 | \$0.60 | \$0.00 | \$0.00 | \$54.38 | \$72.75 |
| 7th 1000 hrs | 90.00 | \$38.90 | \$6.75 | \$1.17 | \$0.39 | \$0.00 | \$9.34 | \$0.60 | \$0.00 | \$0.00 | \$57.15 | \$76.60 |

Special Calculation Note : Other is Health Retirement Account

Operator "A"

John Henry Rock Drill, D-6 (or equivalent) and above, Trackhoe Digger, (320 Track excavator), Cranes (greater then 25 tons and less than 45 tons).

Operator "B"

Cranes (greater than 6 tons and up to 25 tons), Backhoes, Road Tractor, Dozer up to D-5, Pressure Digger- wheeled or tracked, all Tension wire Stringing equipment.

Operator "C"

Trench, Backhoe, Riding type vibratory Compactor, Ground Rod Driver, Boom Truck (6 ton & below), Skid Steer Loaders, Material Handler.

Ratio :

(1) Journeyman Lineman to (1) Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, RICHLAND, ROSS, SCIOTO, SHELBY, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, UNION, VINTON, WARREN, WASHINGTON, WAYNE

Special Jurisdictional Note : 0.30 is for Health Retirement Account.

Details :

Heli - Arc Welding will be paid \$.30 above Journeyman rate. Additional compensation of 10% over the

Journeyman Lineman and Journeyman Technician for performing work on structures outside of buildings such as water towers, smoke stacks, radio and television towers, more than 75' above the ground.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 71 Outside (Central OH Chapter)

Change # : LCN01-2022sksLoc71CentralOhio

Craft : Lineman Effective Date : 08/04/2022 Last Posted : 08/04/2022

| | BHR | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|--------------------------------------|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | |
| Electrical Lineman | \$41.52 | \$7.00 | \$1.25 | \$0.42 | \$0.00 | \$7.89 | \$0.06 | \$0.00 | \$0.00 | \$58.14 | \$78.90 |
| Traffic Signal & Lighting Journeyman | \$39.93 | \$7.00 | \$1.20 | \$0.40 | \$0.00 | \$7.59 | \$0.06 | \$0.00 | \$0.00 | \$56.18 | \$76.15 |
| Equipment Operator | \$36.47 | \$7.00 | \$1.09 | \$0.36 | \$0.00 | \$6.93 | \$0.06 | \$0.00 | \$0.00 | \$51.91 | \$70.15 |
| Groundman 0-12 months (W/O CDL) | \$22.11 | \$7.00 | \$0.66 | \$0.22 | \$0.00 | \$4.20 | \$0.06 | \$0.00 | \$0.00 | \$34.25 | \$45.31 |
| Groundman 0-12 Months W/CDL | \$24.16 | \$7.00 | \$0.72 | \$0.24 | \$0.00 | \$4.59 | \$0.06 | \$0.00 | \$0.00 | \$36.77 | \$48.85 |
| Groundman greater than 1 Year W/CDL | \$26.21 | \$7.00 | \$0.79 | \$0.26 | \$0.00 | \$4.98 | \$0.06 | \$0.00 | \$0.00 | \$39.30 | \$52.41 |
| Traffic Signal Apprentices | | | | | | | | | | | |
| 1st 1,000 hours | \$23.96 | \$7.00 | \$0.72 | \$0.24 | \$0.00 | \$4.55 | \$0.06 | \$0.00 | \$0.00 | \$36.53 | \$48.51 |
| 2nd 1,000 hours | \$25.95 | \$7.00 | \$0.78 | \$0.26 | \$0.00 | \$4.93 | \$0.06 | \$0.00 | \$0.00 | \$38.98 | \$51.96 |
| 3rd 1,000 hours | \$27.95 | \$7.00 | \$0.84 | \$0.28 | \$0.00 | \$5.31 | \$0.06 | \$0.00 | \$0.00 | \$41.44 | \$55.42 |
| 4th 1,000 hours | \$29.95 | \$7.00 | \$0.90 | \$0.30 | \$0.00 | \$5.69 | \$0.06 | \$0.00 | \$0.00 | \$43.90 | \$58.87 |
| 5th 1,000 hours | \$31.94 | \$7.00 | \$0.96 | \$0.32 | \$0.00 | \$6.07 | \$0.06 | \$0.00 | \$0.00 | \$46.35 | \$62.32 |
| 6th 1,000 hours | \$35.94 | \$7.00 | \$1.08 | \$0.36 | \$0.00 | \$6.83 | \$0.06 | \$0.00 | \$0.00 | \$51.27 | \$69.24 |

| Apprentice Lineman | Percent | | | | | | | | | | | |
|--------------------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| | | | | | | | | | | | | |
| 1st 1,000 Hours | 60.00 | \$24.91 | \$7.00 | \$0.75 | \$0.25 | \$0.00 | \$4.73 | \$0.06 | \$0.00 | \$0.00 | \$37.70 | \$50.16 |
| 2nd 1,000 Hours | 65.00 | \$26.99 | \$7.00 | \$0.81 | \$0.27 | \$0.00 | \$5.13 | \$0.06 | \$0.00 | \$0.00 | \$40.26 | \$53.75 |
| 3rd 1,000 Hours | 70.00 | \$29.06 | \$7.00 | \$0.87 | \$0.29 | \$0.00 | \$5.52 | \$0.06 | \$0.00 | \$0.00 | \$42.80 | \$57.34 |
| 4th 1,000 Hours | 75.00 | \$31.14 | \$7.00 | \$0.93 | \$0.31 | \$0.00 | \$5.92 | \$0.06 | \$0.00 | \$0.00 | \$45.36 | \$60.93 |
| 5th 1,000 Hours | 80.00 | \$33.22 | \$7.00 | \$1.00 | \$0.33 | \$0.00 | \$6.31 | \$0.06 | \$0.00 | \$0.00 | \$47.92 | \$64.52 |
| 6th 1,000 Hours | 85.00 | \$35.29 | \$7.00 | \$1.06 | \$0.35 | \$0.00 | \$6.71 | \$0.06 | \$0.00 | \$0.00 | \$50.47 | \$68.12 |
| 7th 1,000 Hours | 90.00 | \$37.37 | \$7.00 | \$1.12 | \$0.37 | \$0.00 | \$7.10 | \$0.06 | \$0.00 | \$0.00 | \$53.02 | \$71.70 |

Special Calculation Note : Other is Safety & Education Fund.

Ratio :

1 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ATHENS, COSHOCTON, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GUERNSEY, HIGHLAND, HOCKING, JACKSON, KNOX, LAWRENCE, LICKING, MADISON, MARION, MEIGS, MONROE, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, RICHLAND, ROSS, SCIOTO, TUSCARAWAS, UNION, VINTON, WASHINGTON

Special Jurisdictional Note :

Details :

A groundman when directed shall assist a Journeyman Lineman, Traffic Signal and Lighting Journeyman or Equipment Operator in the performance of his/her work on the ground, including the use of hand tools. Under no circumstances shall this classification climb poles, towers, or work from an elevated platform or bucket truck. This classification shall not perform work normally assigned to an Apprentice.

No more than three (3) Groundmen shall work alone. Jobs with more that three Groundmen shall be supervised by a Groundcrew Foreman, Journeyman Lineman, Journeyman Traffic Signal Technician or an Equipment Operator.

Scope of Work: installation and maintenance of highway and street lighting, highway and street sign lighting, electronic message boards and traffic control systems, camera systems, traffic signal work, substation and line construction including overhead and underground projects for private and industrial work as in accordance with the IBEW Constitution. This Agreement includes the operation of all tools and equipment necessary for the installation of the above projects.

Prevailing Wage Rate Skilled Crafts

Name of Union: Electrical Local 71 Voice Data Video Outside

Change # : LCR01-2017fbLoc71VDV

Craft : Voice Data Video Effective Date : 10/18/2017 Last Posted : 10/18/2017

| | BHR | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|-----------------------------------|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | |
| Electrical Installer Technician I | \$23.46 | \$5.50 | \$0.70 | \$0.00 | \$0.00 | \$0.30 | \$0.00 | \$0.00 | \$0.00 | \$29.96 | \$41.69 |
| Installer Technician II | \$22.37 | \$5.50 | \$0.67 | \$0.00 | \$0.00 | \$0.30 | \$0.00 | \$0.00 | \$0.00 | \$28.84 | \$40.03 |
| Equipment Operator I | \$22.37 | \$5.50 | \$0.67 | \$0.00 | \$0.00 | \$0.30 | \$0.00 | \$0.00 | \$0.00 | \$28.84 | \$40.03 |
| Equipment Operator II | \$18.43 | \$5.50 | \$0.55 | \$0.00 | \$0.00 | \$0.30 | \$0.00 | \$0.00 | \$0.00 | \$24.78 | \$33.99 |
| Installer/Repair Outside | \$22.37 | \$5.50 | \$0.67 | \$0.00 | \$0.00 | \$0.30 | \$0.00 | \$0.00 | \$0.00 | \$28.84 | \$40.03 |
| Ground Driver W/CDL | \$15.83 | \$5.50 | \$0.47 | \$0.00 | \$0.00 | \$0.30 | \$0.00 | \$0.00 | \$0.00 | \$22.10 | \$30.01 |
| Groundman | \$13.24 | \$5.50 | \$0.40 | \$0.00 | \$0.00 | \$0.30 | \$0.00 | \$0.00 | \$0.00 | \$19.44 | \$26.06 |
| Cable Splicer | \$23.46 | \$5.50 | \$0.70 | \$0.00 | \$0.00 | \$0.30 | \$0.00 | \$0.00 | \$0.00 | \$29.96 | \$41.69 |

Special Calculation Note :

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW,

MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE,
PORTAGE, PREBLE, RICHLAND, ROSS, SCIOTO,
SHELBY, STARK, SUMMIT, TRUMBULL,
TUSCARAWAS, UNION, VINTON, WARREN,
WASHINGTON, WAYNE

Special Jurisdictional Note :

Details :

Cable Splicer: Inspect and test lines or cables, analyze results, and evaluate transmission characteristics. Cover conductors with insulation or seal splices with moisture-proof covering. Install, splice, test, and repair cables using tools or mechanical equipment. This will include the splicing of fiber.

Journeyman Technician I: Must know all aspects of telephone and cable work. This is to include aerial, underground, and manhole work. Must know how to climb and run bucket. Must have all the tools required to perform these tasks. Must be able to be responsible for the safety of the crew at all times. Must also have CDL license and have at least 5 years experience.

Installer/Repairman: Perform tasks of repairing, installing, and testing phone and CATV services.

Technician II: Have at least three years of telephone and CATV experience. Must have the knowledge of underground, aerial, and manhole work. Must be able to climb and operate bucket. Must have CDL. Must have all tools needed to perform these tasks.

Equipment Operator I: Able to operate a digger derrick or bucket truck. Have at least 5 years of experience and must have a valid CDL license.

Equipment Operator II: Able to operate a digger derrick or bucket truck. Have at least 3 years of experience and must have a valid CDL license.

Groundman W/CDL: Must have a valid CDL license and be able to perform tasks such as: climbing poles, pulling downguys, making up material, and getting appropriate tools for the job. Must have at least 5 year's experience.

Groundman: Perform tasks such as: climbing poles, pulling downguys, making up material, and getting appropriate tools for the job. Experience 0-5 years.

Prevailing Wage Rate Skilled Crafts

Name of Union: Elevator Local 45

Change # : LCN01-2022sksLoc45

Craft : Elevator Effective Date : 06/08/2022 Last Posted : 06/08/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|----------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Elevator Mechanic | \$53.30 | | \$16.03 | \$10.71 | \$0.65 | \$4.26 | \$9.50 | \$2.01 | \$0.00 | \$0.00 | \$96.46 | \$123.11 |
| Assistant. Mechanic | \$42.64 | | \$16.03 | \$10.71 | \$0.65 | \$3.41 | \$9.50 | \$1.61 | \$0.00 | \$0.00 | \$84.55 | \$105.87 |
| Helper | \$37.31 | | \$16.03 | \$10.71 | \$0.65 | \$2.98 | \$9.50 | \$1.61 | \$0.00 | \$0.00 | \$78.79 | \$97.45 |
| Apprentice | Percent | | | | | | | | | | | |
| Apprentice | | | | | | | | | | | | |
| 0-6 months Probation | 50.00 | \$26.65 | \$0.00 | \$0.00 | \$0.00 | \$1.60 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$28.25 | \$41.57 |
| 1st year | 55.00 | \$29.32 | \$16.03 | \$10.71 | \$0.65 | \$1.76 | \$9.50 | \$1.10 | \$0.00 | \$0.00 | \$69.06 | \$83.72 |
| 2nd year | 65.01 | \$34.65 | \$16.03 | \$10.71 | \$0.65 | \$2.08 | \$9.50 | \$1.30 | \$0.00 | \$0.00 | \$74.92 | \$92.25 |
| 3rd year | 70.00 | \$37.31 | \$16.03 | \$10.71 | \$0.65 | \$2.24 | \$9.50 | \$1.40 | \$0.00 | \$0.00 | \$77.84 | \$96.49 |
| 4th year | 80.00 | \$42.64 | \$16.03 | \$10.71 | \$0.65 | \$2.56 | \$9.50 | \$1.61 | \$0.00 | \$0.00 | \$83.70 | \$105.02 |

Special Calculation Note : *Other is Holiday Pay

Ratio :

The total number of Helpers & Apprentices employed shall not exceed the number of Mechanics on any one job, except on jobs where (2) teams or more are working, (1) extra Helper or Apprentice may be employed for the first (2) teams and an extra Helper or Apprentice for each additional (3) teams.

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COLUMBIANA, COSHOCTON, HARRISON, HOLMES, MAHONING, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Vacation 6%/under 5 years based on regular hourly rate for all hours worked. 8%/over 5 years based on regular hourly rate for all hours worked.

Prevailing Wage Rate Skilled Crafts

Name of Union: **Glazier Local 1162**

Change # : LCN01-2022sksLoc1162

Craft : Glazier Effective Date : 07/08/2022 Last Posted : 07/08/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Glazier | \$29.02 | | \$6.88 | \$6.79 | \$0.35 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$43.04 | \$57.55 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 6 months | 55.00 | \$15.96 | \$6.88 | \$6.79 | \$0.35 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$29.98 | \$37.96 |
| 2nd 6 months | 60.00 | \$17.41 | \$6.88 | \$6.79 | \$0.35 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$31.43 | \$40.14 |
| 3rd 6 months | 65.00 | \$18.86 | \$6.88 | \$6.79 | \$0.35 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$32.88 | \$42.31 |
| 4th 6 months | 70.00 | \$20.31 | \$6.88 | \$6.79 | \$0.35 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$34.33 | \$44.49 |
| 5th 6 months | 75.02 | \$21.77 | \$6.88 | \$6.79 | \$0.35 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$35.79 | \$46.68 |
| 6th 6 months | 80.00 | \$23.22 | \$6.88 | \$6.79 | \$0.35 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$37.24 | \$48.84 |
| 7th 6 months | 85.00 | \$24.67 | \$6.88 | \$6.79 | \$0.35 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$38.69 | \$51.02 |
| 8th 6 months | 90.00 | \$26.12 | \$6.88 | \$6.79 | \$0.35 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$40.14 | \$53.20 |

Special Calculation Note :

Ratio :

1 Journeyman to 1 Apprentice
2 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COSHOCTON, HOLMES, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TUSCARAWAS, WAYNE

Special Jurisdictional Note :

Details :

Add \$1.25 per hour for High Pay which is all work that requires the employee be supported by equipment which hangs or suspends from the roof of a building or structure including all repelling .

Prevailing Wage Rate Skilled Crafts

Name of Union: Ironworker Local 550

Change # : LCN01-2022sksLoc550

Craft : Ironworker Effective Date : 05/01/2022 Last Posted : 04/27/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Ironworker | \$30.97 | | \$8.98 | \$9.02 | \$0.76 | \$0.00 | \$2.73 | \$0.41 | \$0.00 | \$0.00 | \$52.87 | \$68.35 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 6 months | 65.00 | \$20.13 | \$8.98 | \$9.02 | \$0.76 | \$0.00 | \$2.73 | \$0.41 | \$0.00 | \$0.00 | \$42.03 | \$52.10 |
| 2nd 6 months | 69.00 | \$21.37 | \$8.98 | \$9.02 | \$0.76 | \$0.00 | \$2.73 | \$0.41 | \$0.00 | \$0.00 | \$43.27 | \$53.95 |
| 3rd 6 months | 73.00 | \$22.61 | \$8.98 | \$9.02 | \$0.76 | \$0.00 | \$2.73 | \$0.41 | \$0.00 | \$0.00 | \$44.51 | \$55.81 |
| 4th 6 months | 77.00 | \$23.85 | \$8.98 | \$9.02 | \$0.76 | \$0.00 | \$2.73 | \$0.41 | \$0.00 | \$0.00 | \$45.75 | \$57.67 |
| 5th 6 months | 81.00 | \$25.09 | \$8.98 | \$9.02 | \$0.76 | \$0.00 | \$2.73 | \$0.41 | \$0.00 | \$0.00 | \$46.99 | \$59.53 |
| 6th 6 months | 85.03 | \$26.33 | \$8.98 | \$9.02 | \$0.76 | \$0.00 | \$2.73 | \$0.41 | \$0.00 | \$0.00 | \$48.23 | \$61.40 |
| 7th 6 months | 90.00 | \$27.87 | \$8.98 | \$9.02 | \$0.76 | \$0.00 | \$2.73 | \$0.41 | \$0.00 | \$0.00 | \$49.77 | \$63.71 |
| 8th 6 months | 95.00 | \$29.42 | \$8.98 | \$9.02 | \$0.76 | \$0.00 | \$2.73 | \$0.41 | \$0.00 | \$0.00 | \$51.32 | \$66.03 |

Special Calculation Note : OTHER IS: JOURNEYMAN UPGRADE AND WELLNESS FUND.

Ratio :

- 4 Journeymen to 1 Apprentice
- 1 Journeymen to 1 Apprentice, spinning of cable for suspension bridge
- 1 Journeymen to 1 Apprentice, ornamental work
- 2 Journeymen to 1 Apprentice, reinforcing work
- 1 Journeymen to 2 Apprentice, roadway

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COLUMBIANA*, COSHOCTON, HOLMES*, HURON, MAHONING*, MEDINA*, PORTAGE*, RICHLAND, STARK, SUMMIT*, TUSCARAWAS, WAYNE

Special Jurisdictional Note : The jurisdictional line between Local 17 and Local 550 is determined as follows: All territory North of Old Route 224 line to be within the jurisdiction of Local 17. All territory South of Old Route 224 line is to be the jurisdiction of Local 550, except for everything within the City limits of Barberton which shall be under the jurisdiction of Local 17.

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Ironworker Local 550 Glass & Curtain Wall

Change # : LCN01-2017fbLoc550

Craft : Ironworker Effective Date : 07/01/2017 Last Posted : 06/28/2017

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---------------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Ironworker Glass & Curtain Wall | \$22.00 | | \$7.00 | \$7.47 | \$0.09 | \$0.00 | \$0.33 | \$0.00 | \$0.00 | \$0.00 | \$36.89 | \$47.89 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 6 months | 60.00 | \$13.20 | \$7.00 | \$7.47 | \$0.09 | \$0.00 | \$0.33 | \$0.00 | \$0.00 | \$0.00 | \$28.09 | \$34.69 |
| 2nd 6 months | 65.00 | \$14.30 | \$7.00 | \$7.47 | \$0.09 | \$0.00 | \$0.33 | \$0.00 | \$0.00 | \$0.00 | \$29.19 | \$36.34 |
| 3rd 6 months | 70.00 | \$15.40 | \$7.00 | \$7.47 | \$0.09 | \$0.00 | \$0.33 | \$0.00 | \$0.00 | \$0.00 | \$30.29 | \$37.99 |
| 4th 6 months | 75.00 | \$16.50 | \$7.00 | \$7.47 | \$0.09 | \$0.00 | \$0.33 | \$0.00 | \$0.00 | \$0.00 | \$31.39 | \$39.64 |
| 5th 6 months | 80.00 | \$17.60 | \$7.00 | \$7.47 | \$0.09 | \$0.00 | \$0.33 | \$0.00 | \$0.00 | \$0.00 | \$32.49 | \$41.29 |
| 6th 6 months | 85.00 | \$18.70 | \$7.00 | \$7.47 | \$0.09 | \$0.00 | \$0.33 | \$0.00 | \$0.00 | \$0.00 | \$33.59 | \$42.94 |
| 7th 6 months | 90.00 | \$19.80 | \$7.00 | \$7.47 | \$0.09 | \$0.00 | \$0.33 | \$0.00 | \$0.00 | \$0.00 | \$34.69 | \$44.59 |
| 8th 6 months | 95.00 | \$20.90 | \$7.00 | \$7.47 | \$0.09 | \$0.00 | \$0.33 | \$0.00 | \$0.00 | \$0.00 | \$35.79 | \$46.24 |

Special Calculation Note :

Ratio :

1 Apprentice to 1 Journeymen

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COLUMBIANA*, COSHOCTON, HOLMES, HURON*, MAHONING*, MEDINA*, PORTAGE*, RICHLAND, STARK, SUMMIT*, TUSCARAWAS, WAYNE

Special Jurisdictional Note : The jurisdictional line between Locals 17 and 550 is determined as follows: All territory North of Old Route 224 line is to be within the jurisdiction of Local 17.

All territory South of Old Route 224 line is to be the jurisdiction of Local 550, except for everything within the City limits of Barberton which shall be under the jurisdiction of Local 17.

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Labor HevHwy 3

Change # : LCN01-2022sksLocalHevHwy3

Craft : Laborer Group 1 Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---------------------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|---------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | | |
| Laborer Group 1 | \$34.52 | | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$46.72 | \$63.98 |
| Group 2 | \$34.69 | | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$46.89 | \$64.23 |
| Group 3 | \$35.02 | | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$47.22 | \$64.73 |
| Group 4 | \$35.47 | | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$47.67 | \$65.40 |
| Watch Person | \$27.25 | | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$39.45 | \$53.08 |
| Apprentice Percent | | | | | | | | | | | | |
| 0-1000 hrs | 60.00 | \$20.71 | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$32.91 | \$43.27 |
| 1001-2000 hrs | 70.00 | \$24.16 | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$36.36 | \$48.45 |
| 2001-3000 hrs | 80.00 | \$27.62 | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$39.82 | \$53.62 |
| 3001-4000 hrs | 90.00 | \$31.07 | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$43.27 | \$58.80 |
| More than 4000 hrs | 100.00 | \$34.52 | \$7.70 | \$3.95 | \$0.45 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$46.72 | \$63.98 |

Special Calculation Note : Watchmen have no Apprentices. Tunnel Laborer rate with air-pressurized add \$1.00 to the above wage rate.

Ratio :

1 Journeymen to 1 Apprentice
3 Journeymen to 1 Apprentice thereafter

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, MADISON, MARION, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW,

MUSKINGUM, NOBLE, PAULDING, PERRY,
PICKAWAY, PIKE, PREBLE, PUTNAM, RICHLAND,
ROSS, SCIOTO, SENECA, SHELBY,
TUSCARAWAS, UNION, VAN WERT, VINTON,
WARREN, WASHINGTON, WAYNE, WILLIAMS,
WYANDOT

Special Jurisdictional Note : Hod Carriers and Common Laborers - Heavy, Highway, Sewer, Waterworks, Utility, Airport, Railroad, Industrial and Building Site, Sewer Plant, Waste Water Treatment Facilities Construction

Details :

Group 1

Laborer (Construction); Plant Laborer or Yardman, Right-of-way Laborer, Landscape Laborer, Highway Lighting Worker, Signalization Worker, (Swimming) Pool Construction Laborer, Utility Man, *Bridge Man, Handyman, Joint Setter, Flagperson, Carpenter Helper, Waterproofing Laborer, Slurry Seal, Seal Coating, Surface Treatment or Road Mix Laborer, Riprap Laborer & Grouter, Asphalt Laborer, Dump Man (batch trucks), Guardrail & Fence Installer, Mesh Handler & Placer, Concrete Curing Applicator, Scaffold Erector, Sign Installer, Hazardous Waste (level D), Diver Helper, Zone Person and Traffic Control.

*Bridge Man will perform work as per the October 31, 1949, memorandum on concrete forms, by and between the United Brotherhood of Carpenters and Joiners of America and the Laborers' International Union of North America, which states in; "the moving, cleaning, oiling and carrying to the next point of erection, and the stripping of forms which are not to be re-used, and forms on all flat arch work shall be done by members of the Laborers' International Union of North America."

Group 2

Asphalt Raker, Screwman or Paver, Concrete Puddler, Kettle Man (pipeline), All Machine-Driven Tools (Gas, Electric, Air), Mason Tender, Brick Paver, Mortar Mixer, Skid Steer, Sheeting & Shoring Person, Surface Grinder Person, Screedperson, Water Blast, Hand Held Wand, Power Buggy or Power Wheelbarrow, Paint Striper, Plastic fusing Machine Operator, Rodding Machine Operator, Pug Mill Operator, Operator of All Vacuum Devices Wet or Dry, Handling of all Pumps 4 inches and under (gas, air or electric), Diver, Form Setter, Bottom Person, Welder Helper (pipeline), Concrete Saw Person, Cutting with Burning Torch, Pipe Layer, Hand Spiker (railroad), Underground Person (working in sewer and waterline, cleaning, repairing and reconditioning). Tunnel Laborer (without air), Caisson, Cofferdam (below 25 feet deep), Air Track and Wagon Drill, Sandblaster Nozzle Person, Hazardous Waste (level B), ***Lead Abatement, Hazardous Waste (level C)

***Includes the erecting of structures for the removal, including the encapsulation and containment of Lead abatement process.

Group 3

Blast and Powder Person, Muckers will be defined as shovel men working directly with the miners, Wrencher (mechanical joints & utility pipeline), Yarner, Top Lander, Hazardous Waste (level A), Concrete Specialist, Curb Setter and Cutter, Grade Checker, Concrete Crew in Tunnels. Utility pipeline Tappers, Waterline, Caulker, Signal Person will receive the rate equal to the rate paid the Laborer classification for which the Laborer is signaling.

Group 4

Miner, Welder, Gunitite Nozzle Person

A.) The Watchperson shall be responsible to patrol and maintain a safe traffic zone including but not limited to barrels, cones, signs, arrow boards, message boards etc.

The responsibility of a watchperson is to see that the equipment, job and office trailer etc. are secure.

Prevailing Wage Rate Skilled Crafts

Name of Union: Labor Local 134 Building

Change # : LCN01-2022sksLoc134

Craft : Laborer Effective Date : 05/11/2022 Last Posted : 05/11/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Laborer Group A | \$28.68 | | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$40.83 | \$55.17 |
| Laborer Group B | \$29.08 | | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$41.23 | \$55.77 |
| Laborer Group C | \$29.61 | | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$41.76 | \$56.57 |
| Laborer Group D | \$30.03 | | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$42.18 | \$57.20 |
| Laborer Group E | \$19.40 | | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$31.55 | \$41.25 |
| Apprentice | | | | | | | | | | | | |
| | Percent | | | | | | | | | | | |
| 0-1000 hrs | 60.00 | \$17.21 | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$29.36 | \$37.96 |
| 1001-2000 hrs | 70.00 | \$20.08 | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$32.23 | \$42.26 |
| 2001-3000 hrs | 80.00 | \$22.94 | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$35.09 | \$46.57 |
| 3001-4000 hrs | 90.00 | \$25.81 | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$37.96 | \$50.87 |
| 4001 - Plus | 100.00 | \$28.68 | \$7.70 | \$3.95 | \$0.40 | \$0.00 | \$0.00 | \$0.00 | \$0.10 | \$0.00 | \$40.83 | \$55.17 |

Special Calculation Note : \$0.10 for LECET is for Labor Management

Ratio :

1 Journeymen to 1 Apprentice
3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

COSHOCTON, HOLMES, TUSCARAWAS

Special Jurisdictional Note :

Details :

Group 1

Building and Construction Laborer, Signalman, Flagman, Tool Cribman, Carpenter Tenders, Finisher Tenders, Concrete Handler, Utility Construction Laborer, Guard Rail Erectors, Hazardous Waste Removal and Lead Abatement Level D Personal Protective Equipment (PPE)

Group 2

Bottom Men, Scaffold Builders, Tunnel Laborers, Pipe Layers, Air and Power Driven Tools, Burner on Demolition Work, Swinging Scaffold, Mucker, Caisson Worker, Cofferdam Worker, Powder Men and Dynamite Blasters, Creosote Workers, Form Setter, Plasterer Tender, Hod Carrier, Laser Beam Set-up Man, All Confined Space Work, Furnaces, Pickel Tubs, Acid Pits, and Hazardous Waste Removal and Lead Abatement Level C Personal Protective Equipment. (PPE)

Group 3

Mason Tender, Mortar Mixer, Stonemason Tender, Skid Steer Loader, Hazardous Waste Removal and Lead Abatement Level B Personal Protection Equipment (PPE)

Group 4

Laborers performing work pertaining to or in connection to repair of stoves, stacks, annealing process, soaking pits, coke batteries, boilers, power houses, chemical plants and ethanol plants (under National Maintenance Agreement) Gunnite Operator and Hazardous Waste Removal and Lead Abatement Level A Personal Protective Equipment (PPE)

Group 5

Watchman - Paid a weekly rate with overtime over forty (40) hours at time and one half (1-1/2) plus Health and Welfare, Pension, Training and Upgrading & LECET.

| | | | | | | | | | | | | |
|----------|-------|---------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| 1st Year | 50.00 | \$20.09 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$36.35 | \$46.39 |
| 2nd Year | 60.00 | \$24.11 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$40.36 | \$52.42 |
| 3rd Year | 70.00 | \$28.13 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$44.38 | \$58.45 |
| 4th Year | 80.00 | \$32.15 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$48.40 | \$64.48 |

Special Calculation Note : Other: Education & Safety \$0.09; *Misc is National Training

Ratio :

For every (3) Operating Engineer Journeymen employed by the company there may be employed (1) Registered Apprentice or trainee Engineer through the referral when they are available. An apprentice, while employed as part of a crew per Article VIII, paragraph 78, will not be subject to the apprenticeship ratios in this collective bargaining agreement

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, MADISON, MARION, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WYANDOT

Special Jurisdictional Note :

Details :

Note: There will be a 10% increase for the apprentices on top of the percentages listed above provided they are operating mobile equipment. Mechanic Trainees will receive 10% increase if required to have CDL

Group A- Barrier Moving Machines; Boiler Operators or Compressor Operators, when compressor or boiler is mounted on crane (Piggyback Operation); Boom Trucks (all types); Cableways Cherry Pickers; Combination - Concrete Mixers & Towers; All Concrete Pumps with Booms; Cranes (all types); Compact Cranes, track or rubber over 4,000 pounds capacity; Cranes self-erecting, stationary, track or truck (all configurations); Derricks (all types); Draglines; Dredges (dipper, clam or suction) 3-man crew; Elevating Graders or Euclid Loaders; Floating Equipment; Forklift (rough terrain with winch/hoist); Gradalls; Helicopter Operators, hoisting building materials; Helicopter Winch Operators, Hoisting building materials; Hoes (All types); Hoists (with two or more drums in use); Horizontal Directional Drill; Hydraulic Gantry (lift system); Laser Finishing Machines; Laser Scream and like equipment; Lift Slab or Panel Jack Operators; Locomotives (all types); Maintenance Operator/Technician(Mechanic Operator/Technician and/or Welder); Mixers, paving (multiple drum); Mobile Concrete Pumps, with booms; Panelboards, (all types on site); Pile Drivers; Power Shovels; Prentice Loader; Rail Tamper (with automatic lifting and aligning device); Rotary Drills (all), used on caissons for foundations and sub-structure; Side Booms; Slip Form Pavers; Straddle Carriers (Building Construction on site); Trench Machines (over 24” wide); Tug Boats.

Group B - Articulating/end dumps (minus \$4.00/hour from Group B rate); Asphalt Pavers; Bobcat-type and/or skid steer loader with hoe attachment greater than 7000 lbs.; Bulldozers; CMI type Equipment; Concrete Saw, Vermeer-type; Endloaders; Hydro Milling Machine; Kolman-type Loaders (Dirt Loading); Lead Greasemen; Mucking Machines; Pettibone-Rail Equipment; Power Graders; Power Scoops; Power Scrapers; Push Cats;, Rotomills (all), grinders and planers of all types.

Group C - A-Frames; Air Compressors, Pressurizing Shafts or Tunnels; All Asphalt Rollers; Bobcat-type and/or Skid Steer Loader with or without attachments; Boilers (15 lbs. pressure and over); All Concrete Pumps (without booms with 5 inch system); Fork Lifts (except masonry); Highway Drills - all types (with integral power); Hoists (with one drum); House Elevators (except those automatic call button controlled), Buck Hoists, Transport Platforms, Construction Elevators; Hydro Vac/Excavator (when a second person is needed, the rate of pay will be "Class E"); Man Lifts; Material hoist/elevators; Mud Jacks; Pressure Grouting; Pump Operators (installing or operating Well Points or other types of Dewatering Systems); Pumps (4 inches and over discharge); Railroad Tie (Inserter/Remover); Rotovator (Lime-Soil Stabilizer); Submersible Pumps (4" and over discharge); Switch & Tie Tampers (without lifting and aligning device); Trench Machines (24" and under); Utility Operators.

Group D - Backfillers and Tampers; Ballast Re-locator; Batch Plant Operators; Bar and Joint Installing Machines; Bull Floats; Burlap and Curing Machines; Clefplanes; Compressors, on building construction; Concrete Mixers, more than one bag capacity; Concrete Mixers, one bag capacity (side loaders); All Concrete Pumps (without boom with 4" or smaller system); Concrete Spreader; Conveyors, used for handling building materials; Crushers; Deckhands; Drum Fireman (in asphalt plants); Farm type tractors pulling attachments; Finishing Machines; Form Trenchers; Generators; Guniting Machines; Hydro-seeders; Pavement Breakers (hydraulic or cable); Post Drivers; Post Hole Diggers; Pressure Pumps (over 1/2" discharge); Road Widening Trenchers; Rollers (except asphalt); Self-propelled sub-graders; Shotcrete Machines; Tire Repairmen; Tractors, pulling sheepsfoot post roller or grader; VAC/ALLS; Vibratory Compactors, with integral power; Welders.

Group E – Allen Screed Paver (concrete); Boilers (less than 15 lbs. pressure); Cranes-Compact, track or rubber (under 4,000 pounds capacity); Directional Drill "Locator"; Fueling and greasing +\$3.00; Inboard/outboard Motor Boat Launches; Light Plant Operators; Masonry Fork Lifts; Oilers/Helpers; Power Driven Heaters (oil fired); Power Scrubbers; Power Sweepers; Pumps (under 4 inch discharge); Signalperson, Submersible Pumps (under 4" discharge).

Master Mechanics - Master Mechanic

Cranes 150' – 180' - Boom & Jib 150 - 180 feet

Cranes 180' – 249' - Boom & Jib 180 - 249 feet

Cranes 250' and over - Boom & Jib 250-feet or over

Prevailing Wage Rate Skilled Crafts

Name of Union: Operating Engineers - HevHwy Zone II

Change # : LCN01-2022sksLoc18hevhwyl

Craft : Operating Engineer Effective Date : 05/25/2022 Last Posted : 05/25/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|-----------------------------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Operator Class A | \$40.19 | | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$56.44 | \$76.53 |
| Operator Class B | \$40.07 | | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$56.32 | \$76.35 |
| Operator Class C | \$39.03 | | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$55.28 | \$74.79 |
| Operator Class D | \$37.85 | | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$54.10 | \$73.03 |
| Operator Class E | \$32.39 | | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$48.64 | \$64.83 |
| Master Mechanic | \$40.44 | | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$56.69 | \$76.91 |
| Apprentice Percent | | | | | | | | | | | | |
| 1st Year | 50.00 | \$20.09 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$36.35 | \$46.39 |
| 2nd Year | 60.00 | \$24.11 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$40.36 | \$52.42 |
| 3rd Year | 70.00 | \$28.13 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$44.38 | \$58.45 |
| 4th Year | 80.00 | \$32.15 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$48.40 | \$64.48 |
| Field Mech Trainee Class 2 | | | | | | | | | | | | |
| 1st year | 50.00 | \$20.09 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$36.35 | \$46.39 |
| 2nd year | 60.00 | \$24.11 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$40.36 | \$52.42 |
| 3rd year | 70.00 | \$28.13 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$44.38 | \$58.45 |
| 4th year | 80.00 | \$32.15 | \$9.01 | \$6.25 | \$0.85 | \$0.00 | \$0.00 | \$0.09 | \$0.00 | \$0.05 | \$48.40 | \$64.48 |

Special Calculation Note : Other: Education & Safety Fund is \$0.09 per hour. *Misc is National Training

Ratio :

For every (3) Operating Engineer Journeymen employed by the company, there may be employed (1) Registered Apprentice or Trainee Engineer through the referral when they are available. An Apprentice, while

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DARKE, DEFIANCE,

employed as part of a crew per Article VIII, paragraph 65 will not be subject to the apprenticeship ratios in this collective bargaining agreement

DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LUCAS, MADISON, MARION, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, TUSCARAWAS, UNION, VAN WERT, VINTON, WARREN, WASHINGTON, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

**Apprentices will receive a 10% increase on top of the percentages listed above provided they are operating mobile equipment. Mechanic Trainees will receive 10% increase if they are required to have CDL.

Class A - Air Compressors on Steel Erection; Asphalt Plant Engineers (Cleveland District Only); Barrier Moving Machine; Boiler Operators, Compressor Operators, or Generators, when mounted on a rig; Boom Trucks (all types); Cableways; Cherry Pickers; Combination- Concrete Mixers & Towers; Concrete Plants (over 4 yd capacity); Concrete Pumps; Cranes (all types); Compact Cranes track or rubber over 4,000 pounds capacity; Cranes self-erecting stationary, track or truck; Derricks (all types); Draglines; Dredges dipper, clam or suction; Elevating Graders or Euclid Loaders; Floating Equipment (all types); Gradalls; Helicopter Crew (Operator- hoist or winch); Hoes (all types); Hoisting Engines; Hoisting Engines, on shaft or tunnel work; Hydraulic Gantry (lifting system); Industrial-type Tractors; Jet Engine Dryer (D8 or D9) diesel Tractors; Locomotives (standard gauge); Maintenance Operators/Technicians (class A); Mixers, paving (single or double drum); Mucking Machines; Multiple Scrapers; Piledriving Machines (all types); Power Shovels, Prentice Loader; Quad 9 (double pusher); Rail Tamper (with automatic lifting and aligning device); Refrigerating Machines (freezer operation); Rotary Drills, on caisson work; Rough Terrain Fork Lift with winch/hoist; Side Booms; Slip Form Pavers; Survey Crew Party Chiefs; Tower Derricks; Tree Shredders; Trench Machines (over 24" wide); Truck Mounted Concrete Pumps; Tug Boats; Tunnel Machines and /or Mining Machines; Wheel Excavators.

Class B - Asphalt Pavers; Automatic Subgrade Machines, self-propelled (CMI-type); Bobcat-type and /or Skid Steer Loader with hoe attachment greater than 7000 lbs.; Boring Machine Operators (more than 48 inches); Bulldozers; Concrete Saws, Vermeer type; Endloaders; Horizontal Directional Drill (50,000 ft. lbs. thrust and over); Hydro Milling Machine; Kolman-type Loaders (production type-dirt); Lead Greasemen; Lighting and Traffic Signal Installation Equipment includes all groups or classifications; Maintenance Operators/Technicians, Class B; Material Transfer Equipment (shuttle buggy) Asphalt; Pettibone-Rail Equipment; Power Graders; Power Scrapers; Push Cats; Rotomills (all), Grinders and Planners of all types, Groovers (excluding walk-behinds); Trench Machines (24 inch wide and under).

Class C - A-Frames; Air Compressors, on tunnel work (low Pressure); Articulating/straight bed end dumps if assigned (minus \$4.00 per hour); Asphalt Plant Engineers (Portage and Summit Counties only); Bobcat-type and/or skid steer loader with or without attachments; Drones; Highway Drills (all types); HydroVac/Excavator (when a second person is needed, the rate of pay will be "Class E"); Locomotives (narrow gauge); Material Hoist/Elevators; Mixers, concrete (more than one bag capacity); Mixers, one bag capacity (side loader); Power Boilers (over 15 lbs. pressure); Pump Operators (installing or operating well Points); Pumps (4 inch and over discharge); Railroad Tie Inserter/Remover; Rollers, Asphalt; Rotovator (lime-soil Stabilizer); Switch & Tie Tampers (without lifting and aligning device); Utilities Operators, (small equipment); Welding Machines and

Generators.

Class D – Backfillers and Tampers; Ballast Re-locator; Bar and Joint Installing Machines; Batch Plant Operators; Boring Machine Operators (48 inch or less); Bull Floats; Burlap and Curing Machines; Concrete Plants (capacity 4 yds. and under); Concrete Saws (multiple); Conveyors (highway); Crushers; Deckhands; Farm type tractors, with attachments (highway); Finishing Machines; Firemen, Floating Equipment (all types); Fork Lifts (highway), except masonry; Form Trenchers; Hydro Hammers; Hydro Seeders; Pavement Breakers (hydraulic or cable); Plant Mixers; Post Drivers; Post Hole Diggers; Power Brush Burners; Power Form Handling Equipment; Road Widening Trenchers; Rollers (brick, grade, macadam); Self-Propelled Power Spreaders; Self-Propelled Sub-Graders; Steam Firemen; Survey Instrument men; Tractors, pulling sheepsfoot rollers or graders; Vibratory Compactors, with integral power.

Class E - Compressors (portable, Sewer, Heavy and Highway); Cranes-Compact, track or rubber under 4,000 pound capacity; Drum Firemen (asphalt plant); Fueling and greasing (Primary Operator with Specialized CDL Endorsement Add \$3.00/hr); Generators; Inboard-Outboard Motor Boat Launches; Masonry Fork Lifts; Oil Heaters (asphalt plant); Oilers/Helpers; Power Driven Heaters (oil fired); Power Scrubbers; Power Sweepers; Pumps (under 4 inch discharge); Signalperson; Survey Rodmen or Chairmen; Tire Repairmen; VAC/ALLS. Master Mechanic - Master Mechanic

Prevailing Wage Rate Skilled Crafts

Name of Union: Painter Local 639

Change # : LCNO1-2015fbLoc639

Craft : Painter Effective Date : 06/10/2015 Last Posted : 06/10/2015

| | BHR | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|--------------------------------|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | |
| Painter Metal Finisher/Helpers | | | | | | | | | | | |
| Top Helper Class A | \$19.09 | \$3.65 | \$0.00 | \$0.00 | \$0.66 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$23.40 | \$32.94 |
| Top Helper Class B | \$19.09 | \$3.65 | \$0.65 | \$0.00 | \$1.03 | \$0.00 | \$0.37 | \$0.00 | \$0.00 | \$24.79 | \$34.33 |
| Top Helper Class C | \$19.09 | \$3.65 | \$1.00 | \$0.00 | \$1.76 | \$0.00 | \$0.37 | \$0.00 | \$0.00 | \$25.87 | \$35.41 |
| Helper Class A | \$14.69 | \$3.65 | \$0.00 | \$0.00 | \$0.51 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$18.85 | \$26.19 |
| Helper Class B | \$14.69 | \$3.65 | \$0.65 | \$0.00 | \$0.79 | \$0.00 | \$0.28 | \$0.00 | \$0.00 | \$20.06 | \$27.40 |
| Helper Class C | \$14.69 | \$3.65 | \$1.00 | \$0.00 | \$1.64 | \$0.00 | \$0.28 | \$0.00 | \$0.00 | \$21.26 | \$28.60 |
| New Hire 90 Days | \$11.00 | \$3.65 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$14.65 | \$20.15 |

Special Calculation Note : Other is Sick and Personal Time

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GEAUGA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAKE, LAWRENCE, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE, PUTNAM, RICHLAND, ROSS, SANDUSKY,

SCIOTO, SENECA, SHELBY, STARK, SUMMIT,
TRUMBULL, TUSCARAWAS, UNION, VAN WERT,
VINTON, WARREN, WASHINGTON, WAYNE,
WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

Top Helper: Shall perform the responsibilities of a Helper and be responsible for the setup, break down, safety and quality of the company's product.

Helper : Shall be responsible for performing tasks in refinishing, compliance with safety procedures, setting up and breaking down job sites, scaffolding and swing stages and preparing surfaces for refinishing including but not limited to, masking and stripping and cleaning, oxidizing, polishing and scratch removal on various surfaces

Class A Workers: Less than 1 Year of Service.

Class B Workers: More than 1 and less than 8 Years of Service.

Class C Workers: More than 8 Years of Service.

Metal Polisher Scope of Work: Polishing, buffing, stripping, coloring, lacquering, spraying, cleaning and maintenance of ornamental and architectural metals, iron, bronze, nickel, aluminum and stainless steel and in mental specialty work, various stone finishes, stone specialty work and any other work pertaining to the finishing of metal, stones, woods, and any window washing/cleaning done in conjunction with this work, using chemicals, solvents, coatings and hand applied lacquer thinner, removing scratches from mirror finished metals, burnishing of bronze, statuary finishes on exterior and interior surfaces and the use of all tools required to perform such work, including but not limited to polishes, spray equipment and scaffolding.

Swing State Rate: All work on scaffold 4 sections or higher, including any boom lifts and swing stage scaffolds including the rigging and derigging of hanging/suspended swing stage systems and rappelling/bolson chair work, ADD \$1.50 per hour.

Prevailing Wage Rate Skilled Crafts

Name of Union: Painter Local 639 Zone 2 Sign

Change # : LCN01-2016fbLoc639

Craft : Painter Effective Date : 08/03/2016 Last Posted : 08/03/2016

| | BHR | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|--|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | |
| Painter Sign Journeyman Tech/Team Leader Class A | \$21.25 | \$1.33 | \$0.14 | \$0.00 | \$0.00 | \$0.00 | \$0.57 | \$0.00 | \$0.00 | \$23.29 | \$33.92 |
| Painter Sign Journeyman Tech/Team Leader Class B | \$21.25 | \$1.33 | \$0.14 | \$0.00 | \$0.41 | \$0.00 | \$0.57 | \$0.00 | \$0.00 | \$23.70 | \$34.32 |
| Painter Sign Journeyman Tech/Team Leader Class C | \$21.25 | \$1.33 | \$0.14 | \$0.00 | \$0.82 | \$0.00 | \$0.57 | \$0.00 | \$0.00 | \$24.11 | \$34.74 |
| Painter Sign Journeyman Tech/Team Leader Class D | \$21.25 | \$1.33 | \$0.14 | \$0.00 | \$1.23 | \$0.00 | \$0.57 | \$0.00 | \$0.00 | \$24.52 | \$35.14 |
| Sign Journeyman Class A | \$20.98 | \$1.33 | \$0.14 | \$0.00 | \$0.00 | \$0.00 | \$0.56 | \$0.00 | \$0.00 | \$23.01 | \$33.50 |
| Sign Journeyman Class B | \$20.98 | \$1.33 | \$0.14 | \$0.00 | \$0.40 | \$0.00 | \$0.56 | \$0.00 | \$0.00 | \$23.41 | \$33.90 |
| Sign Journeyman Class C | \$20.98 | \$1.33 | \$0.14 | \$0.00 | \$0.81 | \$0.00 | \$0.56 | \$0.00 | \$0.00 | \$23.82 | \$34.31 |
| Sign Journeyman Class D | \$20.98 | \$1.33 | \$0.14 | \$0.00 | \$1.21 | \$0.00 | \$0.56 | \$0.00 | \$0.00 | \$24.22 | \$34.71 |
| Tech Sign Fabrication/ Erector Class A | \$15.90 | \$1.33 | \$0.14 | \$0.00 | \$0.00 | \$0.00 | \$0.43 | \$0.00 | \$0.00 | \$17.80 | \$25.75 |

| | | | | | | | | | | | |
|---|---------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| Tech Sign Fabrication/ Erector Class B | \$15.90 | \$1.33 | \$0.14 | \$0.00 | \$0.31 | \$0.00 | \$0.43 | \$0.00 | \$0.00 | \$18.11 | \$26.06 |
| Tech Sign Fabrication/ Erector Class C | \$15.90 | \$1.33 | \$0.14 | \$0.00 | \$0.61 | \$0.00 | \$0.43 | \$0.00 | \$0.00 | \$18.41 | \$26.36 |
| Tech Sign Fabrication/ Erector Class D | \$15.90 | \$1.33 | \$0.14 | \$0.00 | \$0.92 | \$0.00 | \$0.43 | \$0.00 | \$0.00 | \$18.72 | \$26.67 |

Special Calculation Note : Other is for paid holidays.

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, AUGLAIZE, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GREENE, HAMILTON, HANCOCK, HARDIN, HENRY, HIGHLAND, HOLMES, HURON, JACKSON, KNOX, LICKING, LOGAN, LORAIN, LUCAS, MADISON, MAHONING, MARION, MERCER, MIAMI, MONTGOMERY, MORROW, MUSKINGUM, OTTAWA, PAULDING, PERRY, PICKAWAY, PIKE, PREBLE, PUTNAM, ROSS, SANDUSKY, SCIOTO, SENECA, SHELBY, STARK, TRUMBULL, TUSCARAWAS, UNION, VAN WERT, WARREN, WAYNE, WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

- Class A: less that 1 year.
- Class B: 1-3 years.
- Class C; 3-10 years.
- Class D: More than 10 years.

Prevailing Wage Rate

Skilled Crafts

Name of Union: Painter Local 841

Change # : LCN01-2021sksLoc841

Craft : Painter Effective Date : 11/17/2021 Last Posted : 11/17/2021

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|---------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | | |
| Painter Brush Roll | \$28.18 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$43.53 | \$57.62 |
| Paperhanger | \$28.18 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$43.53 | \$57.62 |
| Painter Spray Gun Operator Any and Al Coatings) | \$29.03 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$44.38 | \$58.90 |
| Swing Scaffold, Bosum Chair, & Window Jacks | \$28.93 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$44.28 | \$58.75 |
| Sandblast, Painting of Standpipes, etc. from Scaffolds Open Structural Steel, Standpipes and Water Towers | \$29.43 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$44.78 | \$59.50 |
| Epoxy Application | \$28.83 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$44.18 | \$58.60 |
| Synthetic Exterior, Lead Abatement, Asbestos Removal | \$29.43 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$44.78 | \$59.50 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st Year | 53.24 | \$15.00 | \$6.85 | \$2.72 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$25.57 | \$33.07 |
| 2nd Year | 60.00 | \$16.91 | \$6.85 | \$3.14 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$27.90 | \$36.35 |

| | | | | | | | | | | | | |
|----------|-------|---------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| 3rd Year | 70.00 | \$19.73 | \$6.85 | \$3.57 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$31.15 | \$41.01 |
| 4th Year | 80.00 | \$22.54 | \$6.85 | \$4.34 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$34.73 | \$46.01 |

Special Calculation Note : Apprentice pay based on percentage of above appropriate classification.

Ratio :

1 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, COSHOCTON, HOLMES, MEDINA, PORTAGE*, STARK, SUMMIT*, TUSCARAWAS, WAYNE

Special Jurisdictional Note : Summit Cnty: South of and including the Ohio Turnpike, Portage Cnty: North to and including the Ohio Turnpike

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Painter Local 841 Bridge Painter

Change # : LCN01-2021sksLoc841

Craft : Painter Effective Date : 11/17/2021 Last Posted : 11/17/2021

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|--|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Painter Bridge Blaster Class 1 | \$37.85 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$53.20 | \$72.12 |
| Class 2 Bridge Painter, Rigger, Containment Builder, Spot Blaster | \$34.85 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$50.20 | \$67.62 |
| Class 3 Equipment Operator/Field Mechanic, Grit Reclamation, Paint Mixer, Traffic Control, Boat Person, Dive (0-5 Years Exp) | \$27.85 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$43.20 | \$57.13 |
| Class 3 Equipment Operator/Field Mechanic, Grit Reclamation, Paint Mixer, Traffic Control, Boat Person, Dive (5 plus Years Exp). | \$30.85 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$46.20 | \$61.63 |
| Class 4 Concrete Sealing, Concrete Blasting/Power Washing/Etc. | \$30.85 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$46.20 | \$61.63 |
| Class 5 Quality Control/Quality Assurance Traffic Safety, Competent Person. | \$30.85 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$46.20 | \$61.63 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st Year | 50.01 | \$18.93 | \$6.85 | \$2.72 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$29.50 | \$38.96 |
| 2nd Year | 60.00 | \$22.71 | \$6.85 | \$3.14 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$33.70 | \$45.06 |
| 3rd year | 70.00 | \$26.50 | \$6.85 | \$3.57 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$37.92 | \$51.16 |
| 4th Year | 80.00 | \$30.28 | \$6.85 | \$4.34 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$42.47 | \$57.61 |

Special Calculation Note : Apprentice pay based on percentage of above appropriate classification.

Ratio :

1 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, COSHOCTON, HOLMES, MEDINA, PORTAGE*, STARK, SUMMIT*, TUSCARAWAS,

WAYNE

Special Jurisdictional Note : Summit County: South of and including the Ohio Turnpike, Portage County: North to and including the Ohio Turnpike

Details :

Class 1 – Abrasive blasting of any kind

Class 2 – Bridge painting, coating applications of any kind. All steel surface preparation other than abrasive blasting. All necessary rigging and containment building and all remedial/ spot blasting.

Class 3 – Tend to all equipment including but not limited to abrasive blasting, power washing, spray painting, forklifts, hoists, truck, etc. Load and unloading trucks, handle materials, man safety boats, handle traffic control, clean up/ vacuum abrasive blast materials and related tasks.

Class 4 – All aspects of concrete coating/ sealing including but not limited to preparation, containment, etc.

Class 5 – Verify and record that all work is completed according to job specifications. Assure that all health and safety standards are adhered to. Assure all traffic is safely handled.

Prevailing Wage Rate Skilled Crafts

Name of Union: Painter Local 841 (Finisher/Taper)

Change # : LCN01-2021sksLoc841

Craft : Drywall Finisher Effective Date : 11/17/2021 Last Posted : 11/17/2021

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---------------------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|---------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | | |
| Painter Drywall Finisher/PainterTaper | \$29.43 | | \$6.85 | \$7.50 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$44.78 | \$59.50 |
| Apprentice | | | | | | | | | | | | |
| | Percent | | | | | | | | | | | |
| 1st Year | 50.98 | \$15.00 | \$6.85 | \$2.72 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$25.57 | \$33.08 |
| 2nd Year | 65.00 | \$19.13 | \$6.85 | \$3.52 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$30.50 | \$40.06 |
| 3rd Year | 80.00 | \$23.54 | \$6.85 | \$4.34 | \$0.35 | \$0.00 | \$0.65 | \$0.00 | \$0.00 | \$0.00 | \$35.73 | \$47.51 |

Special Calculation Note : Apprentice pay based on percentage of above appropriate classification.

Ratio :

1 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

CARROLL, COSHOCTON, HOLMES, MEDINA, PORTAGE*, STARK, SUMMIT*, TUSCARAWAS, WAYNE

Special Jurisdictional Note : Summit County South of and including the Ohio Turnpike, Portage Cnty: North of and including the Ohio Turnpike

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Plasterer Local 132 (Columbus)

Change # : LCN02-2022sksLoc132

Craft : Plasterer Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|-----------------------|----------------|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | | |
| Plasterer | \$27.64 | | \$7.50 | \$4.20 | \$0.50 | \$0.00 | \$2.00 | \$0.05 | \$0.00 | \$0.00 | \$41.89 | \$55.71 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 800 hrs | 70.00 | \$19.35 | \$7.50 | \$4.20 | \$0.50 | \$0.00 | \$2.00 | \$0.05 | \$0.00 | \$0.00 | \$33.60 | \$43.27 |
| 2nd 800 hrs | 74.00 | \$20.45 | \$7.50 | \$4.20 | \$0.50 | \$0.00 | \$2.00 | \$0.05 | \$0.00 | \$0.00 | \$34.70 | \$44.93 |
| 3rd 800 hrs | 78.00 | \$21.56 | \$7.50 | \$4.20 | \$0.50 | \$0.00 | \$2.00 | \$0.05 | \$0.00 | \$0.00 | \$35.81 | \$46.59 |
| 4th 800 hrs | 82.00 | \$22.66 | \$7.50 | \$4.20 | \$0.50 | \$0.00 | \$2.00 | \$0.05 | \$0.00 | \$0.00 | \$36.91 | \$48.25 |
| 5th 800 hrs | 86.00 | \$23.77 | \$7.50 | \$4.20 | \$0.50 | \$0.00 | \$2.00 | \$0.05 | \$0.00 | \$0.00 | \$38.02 | \$49.91 |
| 6th 800 hrs | 90.00 | \$24.88 | \$7.50 | \$4.20 | \$0.50 | \$0.00 | \$2.00 | \$0.05 | \$0.00 | \$0.00 | \$39.13 | \$51.56 |
| 7th 800 hrs | 94.00 | \$25.98 | \$7.50 | \$4.20 | \$0.50 | \$0.00 | \$2.00 | \$0.05 | \$0.00 | \$0.00 | \$40.23 | \$53.22 |
| 8th 800 hrs | 98.00 | \$27.09 | \$7.50 | \$4.20 | \$0.50 | \$0.00 | \$2.00 | \$0.05 | \$0.00 | \$0.00 | \$41.34 | \$54.88 |

Special Calculation Note : *Other is International Training Fund

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, COSHOCTON, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HOCKING, KNOX, LICKING, MADISON, MARION, MORROW, MUSKINGUM, PERRY, PICKAWAY, RICHLAND, ROSS, UNION, VINTON, WYANDOT

Special Jurisdictional Note :

Details :

PLASTERER IMPROVERS:

Is a person who has skills between an Apprentice and a Journeyman can be signed in as an Improver. An Improver receives 85% of the current wage and pension. All other benefits are same as Journeyman. The Improver has the opportunity to advance to Journeyman level by:

- (1) Working through a trial period of no more than 2,000 hrs.
- (2) Attending all safety and upgrading classes held or required.

Working on swing stage, slip scaffold or window jack scaffold shall receive the following rates:
\$.50 above the regular rate for heights up to fifty (50) feet above grade level

\$1.00 above the regular rate for heights over fifty (50) feet above grade level

Prevailing Wage Rate Skilled Crafts

Name of Union: Plumber Pipefitter Local 495

Change # : LCN01-2021fbLoc495

Craft : Plumber/Pipefitter Effective Date : 06/01/2021 Last Posted : 05/26/2021

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|--|----------------|---------|-------------------------|---------|---------|---------|---------|------------------|-----------|-----------|---------------|---------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | | |
| Plumber/ Pipefitter Fabrication Shop Fitter and Welder | \$32.00 | | \$10.05 | \$5.10 | \$1.20 | \$10.00 | \$6.20 | \$0.00 | \$0.00 | \$0.00 | \$64.55 | \$80.55 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 6 months | 50.00 | \$16.00 | \$10.05 | \$0.00 | \$1.20 | \$10.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$37.25 | \$45.25 |
| 2nd 6 months | 50.00 | \$16.00 | \$10.05 | \$5.10 | \$1.20 | \$10.00 | \$6.20 | \$0.00 | \$0.00 | \$0.00 | \$48.55 | \$56.55 |
| 2nd Year | 60.00 | \$19.20 | \$10.05 | \$5.10 | \$1.20 | \$10.00 | \$6.20 | \$0.00 | \$0.00 | \$0.00 | \$51.75 | \$61.35 |
| 3rd year | 70.00 | \$22.40 | \$10.05 | \$5.10 | \$1.20 | \$10.00 | \$6.20 | \$0.00 | \$0.00 | \$0.00 | \$54.95 | \$66.15 |
| 4th Year | 80.00 | \$25.60 | \$10.05 | \$5.10 | \$1.20 | \$10.00 | \$6.20 | \$0.00 | \$0.00 | \$0.00 | \$58.15 | \$70.95 |
| 5th Year | 90.00 | \$28.80 | \$10.05 | \$5.10 | \$1.20 | \$10.00 | \$6.20 | \$0.00 | \$0.00 | \$0.00 | \$61.35 | \$75.75 |

Special Calculation Note :

Ratio :

- 1 Journeyman to 1 Apprentice
- 2 Journeyman to 1 Apprentices
- 3 Journeyman to 1 Apprentices

Jurisdiction (* denotes special jurisdictional note) :

CARROLL*, COLUMBIANA*, COSHOCTON,
GUERNSEY, HARRISON, HOLMES, JEFFERSON,
MORGAN*, MUSKINGUM, NOBLE,
TUSCARAWAS

Special Jurisdictional Note : Morgan (South to State Route 78 and from McConnelsville, West on SR 37 to the Perry County Line)
Columbiana (in section 35 and west of CR 427 in Section 36).
Townships of Carroll County (Ross, Monroe, Union, Lee, Orange, Perry and London).

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Plumber Pipefitter Local 495 Commercial

Change # : LCN01-2022sksLoc495

Craft : Plumber/Pipefitter Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Plumber Pipefitter/Welder | \$31.24 | | \$10.05 | \$6.00 | \$1.19 | \$8.55 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$64.88 | \$80.50 |
| Refrigeration | \$31.24 | | \$10.05 | \$6.00 | \$1.19 | \$8.55 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$64.88 | \$80.50 |
| HVAC | \$31.24 | | \$10.05 | \$6.00 | \$1.19 | \$8.55 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$64.88 | \$80.50 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 6 months | 50.00 | \$15.62 | \$10.05 | \$0.00 | \$1.19 | \$8.55 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$35.41 | \$43.22 |
| 2nd 6 months | 50.00 | \$15.62 | \$10.05 | \$6.00 | \$1.19 | \$8.55 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$49.26 | \$57.07 |
| 2nd year | 60.00 | \$18.74 | \$10.05 | \$6.00 | \$1.19 | \$8.55 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$52.38 | \$61.76 |
| 3rd year | 70.00 | \$21.87 | \$10.05 | \$6.00 | \$1.19 | \$8.55 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$55.51 | \$66.44 |
| 4th year | 80.00 | \$24.99 | \$10.05 | \$6.00 | \$1.19 | \$8.55 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$58.63 | \$71.13 |
| 5th year | 90.00 | \$28.12 | \$10.05 | \$6.00 | \$1.19 | \$8.55 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$61.76 | \$75.81 |

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

- 1 Apprentice to 1 Journeyman
- 1 Apprentice to 2 Journeyman
- 1 Apprentice to 3 Journeyman
- 1 Apprentice to 4 Journeyman
- 2 Apprentice to 5 Journeyman
- 2 Apprentice to 8 Journeyman
- 3 Apprentice to 9 Journeyman

Jurisdiction (* denotes special jurisdictional note) :

COLUMBIANA*, COSHOCTON, GUERNSEY, HARRISON, HOLMES, MORGAN*, MUSKINGUM, NOBLE, TUSCARAWAS

Special Jurisdictional Note : Morgan (South to State Route 78 and from McConnellsville, West on SR 37 to the Perry County Line)

Columbiana (in section 35 and west of CR 427 in Section 36).

Townships of Carroll County (Ross, Monroe, Union, Lee, Orange, Perry and London).

Details :

All piping for plumbing, water, waste, floor drains, drain grates, supply, leader, soil pipe, grease traps, sewage and vent lines. Water filters, water softeners, water meters and setting of same. House pumps, House tanks swimming pools, ornamental pools, display fountains, drinking fountains, aquariums, plumbing fixtures & appliances, and setting of above equipment. water services from mains to buildings, including meter foundations. Water mains

including fire hydrants. Down spouts and drainage areas catch basins, manholes, drains, gravel basins, storm water sewers, septic tanks, cesspools, water storage tanks. All lawn sprinkler work including piping, fittings, and heads.

Prevailing Wage Rate Skilled Crafts

Name of Union: Plumber Pipefitter Local 495 Industrial

Change # : LCN01-2022sksLoc495Ind

Craft : Plumber/Pipefitter Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|--------------------|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Plumber Pipefitter | \$35.42 | | \$10.05 | \$6.00 | \$1.20 | \$8.95 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$69.47 | \$87.18 |
| Refrigeration | \$35.42 | | \$10.05 | \$6.00 | \$1.20 | \$8.95 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$69.47 | \$87.18 |
| Welder | \$35.42 | | \$10.05 | \$6.00 | \$1.20 | \$8.95 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$69.47 | \$87.18 |
| HVAC | \$35.42 | | \$10.05 | \$6.00 | \$1.20 | \$8.95 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$69.47 | \$87.18 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 6 months | 50.00 | \$17.71 | \$10.05 | \$0.00 | \$1.20 | \$8.95 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$37.91 | \$46.77 |
| 2nd 6 months | 50.00 | \$17.71 | \$10.05 | \$6.00 | \$1.20 | \$8.95 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$51.76 | \$60.62 |
| 2nd year | 60.00 | \$21.25 | \$10.05 | \$6.00 | \$1.20 | \$8.95 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$55.30 | \$65.93 |
| 3rd year | 70.00 | \$24.79 | \$10.05 | \$6.00 | \$1.20 | \$8.95 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$58.84 | \$71.24 |
| 4th year | 80.00 | \$28.34 | \$10.05 | \$6.00 | \$1.20 | \$8.95 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$62.39 | \$76.55 |
| 5th year | 90.00 | \$31.88 | \$10.05 | \$6.00 | \$1.20 | \$8.95 | \$7.85 | \$0.00 | \$0.00 | \$0.00 | \$65.93 | \$81.87 |

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

- 1 Apprentice to 1 Journeyman
- 1 Apprentice to 2 Journeyman
- 1 Apprentice to 3 Journeyman
- 1 Apprentice to 4 Journeyman
- 2 Apprentice to 5 Journeyman
- 2 Apprentice to 8 Journeyman
- 3 Apprentice to 9 Journeyman

Jurisdiction (* denotes special jurisdictional note) :

COLUMBIANA*, COSHOCTON, GUERNSEY, HARRISON, HOLMES, MORGAN*, MUSKINGUM, NOBLE, TUSCARAWAS

Special Jurisdictional Note : Morgan (South to State Route 78 and from McConnelsville, West on SR 37 to the Perry County Line)
Columbiana (in section 35 and west of CR 427 in Section 36).
Townships of Carroll County (Ross, Monroe, Union, Lee, Orange, Perry and London).

Details :

Prevailing Wage Rate

Skilled Crafts

Name of Union: **Roofer Local 88**

Change # : LCN01-2022sksLoc88

Craft : Roofer Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|--------------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Roofer | \$29.07 | | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$49.85 | \$64.39 |
| HELPERS | | | | | | | | | | | | |
| Helper -500 Hrs. 1st 6 months | \$16.27 | | \$2.25 | \$0.00 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$20.60 | \$28.73 |
| Helper - 500 Hrs. 2nd 6 months | \$18.02 | | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$38.80 | \$47.81 |
| 2nd year Helper | \$19.76 | | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$40.54 | \$50.42 |
| 3rd year Helper | \$21.51 | | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$42.29 | \$53.05 |
| 4th year Helper | \$23.25 | | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$44.03 | \$55.66 |
| 5th year Helper | \$25.00 | | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$45.78 | \$58.28 |
| Apprentice | Percent | | | | | | | | | | | |
| 1st 6 months w/500 hrs | 55.97 | \$16.27 | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$37.05 | \$45.19 |
| 2nd 6 months w/500 hrs | 62.00 | \$18.02 | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$38.80 | \$47.82 |
| 3rd 6 months w/500 hrs | 67.97 | \$19.76 | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$40.54 | \$50.42 |
| 4th 6 months w/500 hrs | 74.00 | \$21.51 | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$42.29 | \$53.05 |
| 5th 6 months w/500 hrs | 79.98 | \$23.25 | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$44.03 | \$55.66 |

| | | | | | | | | | | | | |
|------------------------|-------|---------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
| 6th 6 months w/500 hrs | 86.00 | \$25.00 | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$45.78 | \$58.28 |
| 7th 6 months w/500 hrs | 92.00 | \$26.74 | \$8.90 | \$9.80 | \$0.40 | \$0.00 | \$1.50 | \$0.18 | \$0.00 | \$0.00 | \$47.52 | \$60.90 |

Special Calculation Note : Roofers working in any form of coal tar pitch, whether hot or cold, installing and/or removing will be paid \$.25 more per hour.
Other \$0.18 is for C.I.D.B.

Ratio :

No helper shall be used on any one job unless 1 Journeymen, and 1 Apprentices are working on said job .One
(1) Journeymen to One (1) Apprentice to One (1) Helper

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COSHOCTON, CRAWFORD, HOLMES, HURON, LORAIN*, MEDINA, PORTAGE, RICHLAND, STARK, SUMMIT, TUSCARAWAS, WAYNE

Special Jurisdictional Note : In Lorain County (South of the Turnpike)

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Sheet Metal Local 33 Industrial Door

Change # : LCN01-2022sksLoc33Industrial DoorClev

Craft : Sheet Metal Worker Effective Date : 08/01/2022 Last Posted : 07/27/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---------------------------------|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Sheet Metal Worker | \$23.92 | | \$8.66 | \$5.55 | \$0.17 | \$0.00 | \$2.15 | \$0.00 | \$0.00 | \$0.00 | \$40.45 | \$52.41 |
| Trainees | | | | | | | | | | | | |
| | Percent | | | | | | | | | | | |
| 1st 60 days Probationary Perios | 52.00 | \$12.44 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$12.44 | \$18.66 |
| 61st day-12 months | 58.00 | \$13.87 | \$8.66 | \$1.92 | \$0.17 | \$0.00 | \$1.41 | \$0.00 | \$0.00 | \$0.00 | \$26.03 | \$32.97 |
| 2nd yr | 68.00 | \$16.27 | \$8.66 | \$1.92 | \$0.17 | \$0.00 | \$1.59 | \$0.00 | \$0.00 | \$0.00 | \$28.61 | \$36.74 |
| 3rd yr | 73.00 | \$17.46 | \$8.66 | \$1.92 | \$0.17 | \$0.00 | \$1.69 | \$0.00 | \$0.00 | \$0.00 | \$29.90 | \$38.63 |
| 4th yr | 80.00 | \$19.14 | \$8.66 | \$1.92 | \$0.17 | \$0.00 | \$1.80 | \$0.00 | \$0.00 | \$0.00 | \$31.69 | \$41.25 |
| 5th yr | 86.00 | \$20.57 | \$8.66 | \$1.92 | \$0.17 | \$0.00 | \$1.91 | \$0.00 | \$0.00 | \$0.00 | \$33.23 | \$43.52 |

Special Calculation Note :

Ratio :

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, ASHTABULA, CARROLL, COLUMBIANA, COSHOCTON, CRAWFORD, CUYAHOGA, DEFIANCE, ERIE, FULTON, GEauga, HANCOCK, HENRY, HOLMES, HURON, LAKE, LORAIN, LUCAS, MAHONING, MEDINA, OTTAWA, PAULDING, PORTAGE, PUTNAM, RICHLAND, SANDUSKY, SENECA, STARK, SUMMIT, TRUMBULL, TUSCARAWAS, WAYNE, WILLIAMS, WOOD

Special Jurisdictional Note :

Details :

Prevailing Wage Rate Skilled Crafts

Name of Union: Sheet Metal Local 33 (Akron)

Change # : LCN01-2022sksLoc33Akron

Craft : Sheet Metal Worker Effective Date : 06/01/2022 Last Posted : 06/01/2022

| | BHR | | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|---|----------------|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | | |
| Sheet Metal Worker | \$33.89 | | \$9.35 | \$13.20 | \$0.93 | \$0.00 | \$7.20 | \$0.00 | \$0.00 | \$0.00 | \$64.57 | \$81.52 |
| Apprentice | Percent | | | | | | | | | | | |
| Apprentice | | | | | | | | | | | | |
| 1st year | 60.00 | \$20.33 | \$9.35 | \$4.81 | \$0.17 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$34.66 | \$44.83 |
| 2nd year | 65.00 | \$22.03 | \$9.35 | \$5.97 | \$0.93 | \$0.00 | \$3.60 | \$0.00 | \$0.00 | \$0.00 | \$41.88 | \$52.89 |
| 3rd year | 70.00 | \$23.72 | \$9.35 | \$6.37 | \$0.93 | \$0.00 | \$3.60 | \$0.00 | \$0.00 | \$0.00 | \$43.97 | \$55.83 |
| 4th year | 80.00 | \$27.11 | \$9.35 | \$7.18 | \$0.93 | \$0.00 | \$3.60 | \$0.00 | \$0.00 | \$0.00 | \$48.17 | \$61.73 |
| 5th year as of May 1, 2022 until completion of apprenticeship | 80.00 | \$27.11 | \$9.35 | \$7.18 | \$0.93 | \$0.00 | \$3.60 | \$0.00 | \$0.00 | \$0.00 | \$48.17 | \$61.73 |

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

1 Journeymen to 1 Apprentice
 2 Journeymen to 1 Apprentice
 3 Journeymen to 2 Apprentice
 4 Journeymen to 2 Apprentice
 5-7 Journeymen to 3 Apprentice
 8-10 Journeymen to 4 Apprentice
 11-13 Journeymen to 5 Apprentice
 14, 15 Journeymen to 6 Apprentice
 and maintaining a three to one apprentice ratio thereafter.

Jurisdiction (* denotes special jurisdictional note) :

ASHLAND, CARROLL, COSHOCTON,
 CRAWFORD, HOLMES, MEDINA, PORTAGE,
 RICHLAND, STARK, SUMMIT, TUSCARAWAS,
 WAYNE

Special Jurisdictional Note :

Details :

Scope of Work: This Agreement covers the rates of pay and conditions of employment of all employees of the Employer engaged in, but not limited to, the a) manufacture, fabrication, assembling, handling, erection, installation, dismantling, conditioning, adjustment, alteration, repairing and servicing of all ferrous or non-

ferrous metal work and all other materials used in lieu thereof and of all HVAC systems, air-veyor systems, exhaust systems, and air handling systems regardless of material used, including the setting of all equipment and all reinforcements in connection therewith; (b) all lagging over insulation and all duct-lining; (c) testing, servicing, and balancing of all air-handling equipment and duct work; (d) the preparation of all shop and field sketches, whether manually drawn or computer assisted, used in fabrication and erection, including those taken from original architectural and engineering drawings or sketches, and (e) metal roofing; and (f) all other work included in the jurisdictional claims of Sheet Metal Worker's International Association.

Industrial Door-Installation and service of overhead doors roll up doors, docks and dock leveling.

Prevailing Wage Rate Skilled Crafts

Name of Union: Sprinkler Fitter Local 669

Change # : LCN01-2022sksLoc669

Craft : Sprinkler Fitter Effective Date : 04/06/2022 Last Posted : 04/06/2022

| | BHR | | Fringe Benefit Payments | | | | | | Irrevocable Fund | | Total PWR | Overtime Rate |
|--|----------------|---------|-------------------------|---------|---------|--------|---------|--------|------------------|----------|-----------|---------------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | | |
| Sprinkler Fitter | \$43.75 | | \$10.99 | \$7.10 | \$0.52 | \$0.00 | \$5.12 | \$0.00 | \$0.00 | \$0.00 | \$67.48 | \$89.35 |
| Apprentice Indentured after April 1, 2013 | | | | | | | | | | | | |
| | Percent | | | | | | | | | | | |
| CILASS 1 | 45.00 | \$19.69 | \$7.85 | \$0.00 | \$0.52 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$28.06 | \$37.90 |
| CLASS 2 | 50.02 | \$21.88 | \$7.85 | \$0.00 | \$0.52 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$30.25 | \$41.20 |
| CLASS 3 | 54.43 | \$23.81 | \$10.99 | \$7.10 | \$0.52 | \$0.00 | \$1.15 | \$0.00 | \$0.00 | \$0.00 | \$43.57 | \$55.48 |
| CLASS 4 | 59.43 | \$26.00 | \$10.99 | \$7.10 | \$0.52 | \$0.00 | \$1.15 | \$0.00 | \$0.00 | \$0.00 | \$45.76 | \$58.76 |
| CLASS 5 | 64.43 | \$28.19 | \$10.99 | \$7.10 | \$0.52 | \$0.00 | \$1.40 | \$0.00 | \$0.00 | \$0.00 | \$48.20 | \$62.29 |
| CLASS 6 | 69.43 | \$30.38 | \$10.99 | \$7.10 | \$0.52 | \$0.00 | \$1.40 | \$0.00 | \$0.00 | \$0.00 | \$50.39 | \$65.57 |
| CLASS 7 | 74.43 | \$32.56 | \$10.99 | \$7.10 | \$0.52 | \$0.00 | \$1.40 | \$0.00 | \$0.00 | \$0.00 | \$52.57 | \$68.85 |
| CLASS 8 | 79.42 | \$34.75 | \$10.99 | \$7.10 | \$0.52 | \$0.00 | \$1.40 | \$0.00 | \$0.00 | \$0.00 | \$54.76 | \$72.13 |
| CLASS 9 | 84.43 | \$36.94 | \$10.99 | \$7.10 | \$0.52 | \$0.00 | \$1.40 | \$0.00 | \$0.00 | \$0.00 | \$56.95 | \$75.42 |
| CLASS 10 | 89.44 | \$39.13 | \$10.99 | \$7.10 | \$0.52 | \$0.00 | \$1.40 | \$0.00 | \$0.00 | \$0.00 | \$59.14 | \$78.70 |

Special Calculation Note :

Ratio :

1 Journeyman to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE, GUERNSEY, HAMILTON, HANCOCK, HARDIN, HARRISON, HENRY, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON, KNOX, LAWRENCE, LICKING, LOGAN, LUCAS, MADISON, MAHONING, MARION, MEDINA, MEIGS, MERCER, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW,

MUSKINGUM, NOBLE, OTTAWA, PAULDING,
PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE,
PUTNAM, RICHLAND, ROSS, SANDUSKY,
SCIOTO, SENECA, SHELBY, STARK, SUMMIT,
TRUMBULL, TUSCARAWAS, UNION, VAN WERT,
VINTON, WARREN, WASHINGTON, WAYNE,
WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

Sprinkler Fitter work shall consist of the installation, dismantling, maintenance, repairs, adjustments, and corrections of all fire protection and fire control systems including the unloading, handling by hand, power equipment and installation of all piping or tubing, appurtenances and equipment pertaining thereto, including both overhead and underground water mains, fire hydrants and hydrant mains, standpipes and hose connections to sprinkler systems used in connection with sprinkler and alarm systems. Also all tanks and pumps connected thereto, also included shall be CO-2 and Cardox Systems, Dry Chemical Systems, Foam Systems and all other fire protection systems.

Prevailing Wage Rate Skilled Crafts

**Name of Union: Truck Driver Bldg & Hwy Class 1
Locals 20,40,92,92b,100,175,284,438,377,637,908,957**

Change # : LCRO1-2021fbBldgHwy

Craft : Truck Driver Effective Date : 05/21/2021 Last Posted : 05/21/2021

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---|---------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|---------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | MISC (*) | | |
| Classification | | | | | | | | | | | | |
| Truck Driver CLASS 1 4 wheel service, dump, and batch trucks, Oil Distributor - Asphalt Distributor-Tandems | \$29.24 | | \$7.50 | \$8.50 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$45.44 | \$60.06 |
| Apprentice | Percent | | | | | | | | | | | |
| First 6 months | 80.00 | \$23.39 | \$7.50 | \$8.50 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$39.59 | \$51.29 |
| 7-12 months | 85.00 | \$24.85 | \$7.50 | \$8.50 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$41.05 | \$53.48 |
| 13-18 months | 90.00 | \$26.32 | \$7.50 | \$8.50 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$42.52 | \$55.67 |
| 19-24 months | 95.00 | \$27.78 | \$7.50 | \$8.50 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$43.98 | \$57.87 |
| 25-30 months | 100.00 | \$29.24 | \$7.50 | \$8.50 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$45.44 | \$60.06 |

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE,

GUERNSEY, HAMILTON, HANCOCK, HARDIN,
HARRISON, HENRY, HIGHLAND, HOCKING,
HOLMES, HURON, JACKSON, JEFFERSON,
KNOX, LAWRENCE, LICKING, LOGAN, LORAIN,
LUCAS, MADISON, MAHONING, MARION,
MEDINA, MEIGS, MERCER, MIAMI, MONROE,
MONTGOMERY, MORGAN, MORROW,
MUSKINGUM, NOBLE, OTTAWA, PAULDING,
PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE,
PUTNAM, RICHLAND, ROSS, SANDUSKY,
SCIOTO, SENECA, SHELBY, STARK, SUMMIT,
TRUMBULL, TUSCARAWAS, UNION, VAN WERT,
VINTON, WARREN, WASHINGTON, WAYNE,
WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

** Asphalt - Oil spray bar man when operating from cab shall receive \$0.20 cents per hour above their Basic Hourly Rate.

Prevailing Wage Rate

Skilled Crafts

**Name of Union: Truck Driver Bldg & HevHwy Class 2
Locals 20,40,92,92b,100,175,284,438,377,637,908,957**

Change # : LCNO1-2022sksBldgHevHwy

Craft : Truck Driver Effective Date : 06/08/2022 Last Posted : 06/08/2022

| | BHR | | Fringe Benefit Payments | | | | | Irrevocable Fund | | Total PWR | Overtime Rate | |
|---|----------------|---------|-------------------------|---------|---------|--------|---------|------------------|-----------|-----------|---------------|----------|
| | | | H&W | Pension | App Tr. | Vac. | Annuity | Other | LECET (*) | | | MISC (*) |
| Classification | | | | | | | | | | | | |
| Truck Driver CLASS 2 Tractor Trailer-Semi Tractor Trucks-Pole Trailers-Ready Mix Trucks-Fuel Trucks- Asphalt-Oil Spray bar men- 5 Axle & Over - Belly Dumps-End Dumps-Articulated Dump Trucks- Low boys-Heavy duty Equipment(irrespective of load carried) when used exclusively for transportation-Truck Mechanics (when needed) | \$30.81 | | \$7.50 | \$8.80 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$47.31 | \$62.72 |
| Apprentice | Percent | | | | | | | | | | | |
| First 6 months | 79.98 | \$24.64 | \$7.50 | \$8.80 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$41.14 | \$53.46 |
| 7-12 months | 87.25 | \$26.88 | \$7.50 | \$8.80 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$43.38 | \$56.82 |
| 13-18 months | 90.00 | \$27.73 | \$7.50 | \$8.80 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$44.23 | \$58.09 |
| 19-24 months | 94.98 | \$29.26 | \$7.50 | \$8.80 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$45.76 | \$60.40 |
| 25-30 months | 100.00 | \$30.81 | \$7.50 | \$8.80 | \$0.20 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$47.31 | \$62.72 |

Special Calculation Note : No special calculations for this skilled craft wage rate are required at this time.

Ratio :

3 Journeymen to 1 Apprentice

Jurisdiction (* denotes special jurisdictional note) :

ADAMS, ALLEN, ASHLAND, ASHTABULA, ATHENS, AUGLAIZE, BELMONT, BROWN, BUTLER, CARROLL, CHAMPAIGN, CLARK, CLERMONT, CLINTON, COLUMBIANA, COSHOCTON, CRAWFORD, DARKE, DEFIANCE, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, FULTON, GALLIA, GREENE,

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KNOX, LAWRENCE, LICKING, LOGAN, LORAIN,
LUCAS, MADISON, MAHONING, MARION,
MEDINA, MEIGS, MERCER, MIAMI, MONROE,
MONTGOMERY, MORGAN, MORROW,
MUSKINGUM, NOBLE, OTTAWA, PAULDING,
PERRY, PICKAWAY, PIKE, PORTAGE, PREBLE,
PUTNAM, RICHLAND, ROSS, SANDUSKY,
SCIOTO, SENECA, SHELBY, STARK, SUMMIT,
TRUMBULL, TUSCARAWAS, UNION, VAN WERT,
VINTON, WARREN, WASHINGTON, WAYNE,
WILLIAMS, WOOD, WYANDOT

Special Jurisdictional Note :

Details :

** Asphalt - Oil spray bar man when operating from cab shall receive \$0.20 cents per hour above their Basic Hourly Rate.



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Classification = All, County = COSHOCTON, Union = All

| County | Classification | Effective | Posted | Union |
|---------------------------|------------------------------------|----------------------------|----------------------------|--|
| COSHOCTON | Asbestos Worker | 8/23/2018 | 8/23/2018 | Asbestos Local 207 OH |
| COSHOCTON | Asbestos Worker | 9/21/2022 | 9/21/2022 | Asbestos Local 3 Heat & Frost Insulators |
| COSHOCTON | Asbestos Worker | 6/6/2018 | 6/6/2018 | Asbestos Local 84 Heat & Frost Insulators |
| COSHOCTON | Boilermaker | 4/3/2019 | 4/3/2019 | Boilermaker Local 744 |
| COSHOCTON | Bricklayer | 6/1/2022 | 6/1/2022 | Bricklayer Local 44 |
| COSHOCTON | Bricklayer | 6/1/2022 | 6/1/2022 | Bricklayer Local 55 Tile Setter |
| COSHOCTON | Bricklayer | 6/1/2022 | 6/1/2022 | Bricklayer Local 55 Tile & Marble Finisher |
| COSHOCTON | Carpenter | 6/15/2022 | 6/15/2022 | Carpenter Commercial NE Zone 2C |
| COSHOCTON | Carpenter | 6/15/2022 | 6/15/2022 | Carpenter Floorlayer NE Zone 2C |
| COSHOCTON | Carpenter | 6/15/2022 | 6/15/2022 | Carpenter Insulation NE Zone 2C |
| COSHOCTON | Carpenter | 7/6/2022 | 7/6/2022 | Carpenter Millwright NE Zone M2 |
| COSHOCTON | Carpenter | 3/5/2014 | 3/5/2014 | Carpenter NE District Industrial Dock & Door |
| COSHOCTON | Carpenter | 6/15/2022 | 6/15/2022 | Carpenter Pile Driver NE Zone P2 |
| COSHOCTON | Bricklayer | 6/8/2022 | 6/8/2022 | Cement Mason Bricklayer Local 97 HevHwy A |
| COSHOCTON | Bricklayer | 6/8/2022 | 6/8/2022 | Cement Mason Bricklayer Local 97 HevHwy B |
| COSHOCTON | Cement | 6/1/2022 | 6/1/2022 | Cement Mason Local 132 (Columbus) |
| COSHOCTON | Cement Mason | 5/5/2022 | 5/5/2022 | Cement Mason Statewide HevHwy |
| COSHOCTON | Electrical | 6/29/2022 | 6/29/2022 | Electrical Local 1105 Inside |
| COSHOCTON | Electrical | 6/29/2022 | 6/29/2022 | Electrical Local 1105 Inside Lt Commercial South West |
| COSHOCTON | Voice Data Video | 6/29/2022 | 6/29/2022 | Electrical Local 1105 Voice Data Video |
| COSHOCTON | Lineman | 3/16/2021 | 3/16/2021 | Electrical Local 71 High Tension Pipe Type Cable |
| COSHOCTON | Lineman | 3/16/2021 | 3/16/2021 | Electrical Local 71 Outside Utility Power |
| COSHOCTON | Lineman | 8/4/2022 | 8/4/2022 | Electrical Local 71 Outside (Central OH Chapter) |
| COSHOCTON | Voice Data Video | 10/18/2017 | 10/18/2017 | Electrical Local 71 Voice Data Video Outside |
| COSHOCTON | Elevator | 6/8/2022 | 6/8/2022 | Elevator Local 45 |
| COSHOCTON | Glazier | 7/8/2022 | 7/8/2022 | Glazier Local 1162 |
| COSHOCTON | Ironworker | 5/1/2022 | 4/27/2022 | Ironworker Local 550 |
| COSHOCTON | Ironworker | 7/1/2017 | 6/28/2017 | Ironworker Local 550 Glass & Curtain Wall |
| COSHOCTON | Laborer Group 1 | 6/1/2022 | 6/1/2022 | Labor HevHwy 3 |
| COSHOCTON | Laborer | 5/11/2022 | 5/11/2022 | Labor Local 134 Building |
| COSHOCTON | Operating Engineer | 5/25/2022 | 5/25/2022 | Operating Engineers - Building Local 18 - Zone III |
| COSHOCTON | Operating Engineer | 5/25/2022 | 5/25/2022 | Operating Engineers - HevHwy Zone II |
| COSHOCTON | Painter | 6/10/2015 | 6/10/2015 | Painter Local 639 |
| COSHOCTON | Painter | 8/3/2016 | 8/3/2016 | Painter Local 639 Zone 2 Sign |
| COSHOCTON | Painter | 11/17/2021 | 11/17/2021 | Painter Local 841 |
| COSHOCTON | Painter | 11/17/2021 | 11/17/2021 | Painter Local 841 Bridge Painter |
| COSHOCTON | Drywall Finisher | 11/17/2021 | 11/17/2021 | Painter Local 841 (Finisher/Taper) |
| COSHOCTON | Plasterer | 6/1/2022 | 6/1/2022 | Plasterer Local 132 (Columbus) |
| COSHOCTON | Plumber/Pipefitter | 6/1/2021 | 5/26/2021 | Plumber Pipefitter Local 495 |
| COSHOCTON | Plumber/Pipefitter | 6/1/2022 | 6/1/2022 | Plumber Pipefitter Local 495 Commercial |
| COSHOCTON | Plumber/Pipefitter | 6/1/2022 | 6/1/2022 | Plumber Pipefitter Local 495 Industrial |
| COSHOCTON | Roofer | 6/1/2022 | 6/1/2022 | Roofer Local 88 |
| COSHOCTON | Sheet Metal Worker | 8/1/2022 | 7/27/2022 | Sheet Metal Local 33 Industrial Door |
| COSHOCTON | Sheet Metal Worker | 6/1/2022 | 6/1/2022 | Sheet Metal Local 33 (Akron) |
| COSHOCTON | Sprinkler Fitter | 4/6/2022 | 4/6/2022 | Sprinkler Fitter Local 669 |
| COSHOCTON | Truck Driver | 5/21/2021 | 5/21/2021 | Truck Driver Bldg & HevHwy Class 1 Locals 20,40,92,92b,100,175,284,438,377,637,908,957 |
| COSHOCTON | Truck Driver | 6/8/2022 | 6/8/2022 | Truck Driver Bldg & HevHwy Class 2 Locals 20,40,92,92b,100,175,284,438,377,637,908,957 |

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Contractor's use of site and premises.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and Drawing conventions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

- A. Project Identification: Coshocton Public Library HVAC Upgrades.

1. Project Location: 655 Main Street, Coshocton, OH 43812

- B. Owner: Coshocton Public Library.

1. Owner's Representative: Jennifer Austin, Phone: 740-622-0956, Email: jaustin@coshoctonlibrary.org.

- C. Architect: H.F. Lenz Company, Johnstown PA.

1. Architect's Representative: Luke Shumaker, H.F. Lenz Company, 1407 Scalp Ave. Johnstown PA, 15904 Phone: 814-269-9300.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
 - 1. Partial demolition of existing HVAC, electrical, and plumbing work.
 - 2. Piping, ductwork, insulation, automatic controls and rooftop air-handling unit.
 - 3. Associated and supporting electrical, plumbing, and structural / architectural work.
 - 4. Testing, balancing, startup, and commissioning of new systems and controls.
 - 5. Other Work indicated in the Contract Documents.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.
- C. Prevailing Wages:
 - 1. Prevailing Wages are required. Rates are included in this manual.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated by requirements of this Section.
- B. Limits on Use of Site: Limit use of Project site to Work in areas indicated on the Drawings and as specified in this Section. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Refer to Division 01 Section "Temporary Facilities And Controls" for restrictions and requirements on parking, storage of materials, and permitted location for a dumpster.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- E. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 - 1. Weekend and Extended Hours: Permitted upon approval of the Owner no less than three (3) business days in advance.
 - 2. Utility Shutdowns: Upon approval of the Owner no less than two (2) business days in advance.
 - a. Electrical and fire alarm shutdowns shall be limited to four (4) hours in duration. Only one (1) such shutdown per week is permitted.
 - b. HVAC service shutdowns, other than that of the air-handling system, shall be limited to eight (8) hours in duration. Only one (1) such shutdown per week is permitted.
 - 3. Hours for Core Drilling, or any other noisy work activity producing a sound level exceeding 60 dBA in occupied spaces:
 - a. Between 8pm and 10pm, upon approval of the Owner no less than two (2) business days in advance.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than five (5) days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.

- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances within the existing building, on Project site, or on Owner's property is not permitted.
- F. Employee Identification: Contractor will provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.

1.10 LIQUIDATED DAMAGES

- A. See Section 3.4 of the Owner-Contractor Agreement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles. Pre-bid substitution requests shall be according to Section J of the Instructions to Bidders. Following award of the Contract, there shall be no substitutions for specified products, except pursuant to a Change Order.
 - 1. Substitution Request Form: For pre-bid substitution requested use the form provided in the Contract Documents. Following award of the Contract, there shall be no substitutions for specified products, except pursuant to a Change Order.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

- a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

- 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- b. Substitution request is fully documented and properly submitted.
- c. Requested substitution will not adversely affect Contractor's construction schedule.
- d. Requested substitution has received necessary approvals of authorities having jurisdiction.
- e. Requested substitution is compatible with other portions of the Work.
- f. Requested substitution has been coordinated with other portions of the Work.
- g. Requested substitution provides specified warranty.
- h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.

- d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Document 004373 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
 - 2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.

6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.

11. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
12. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the 25th of each month for work completed to date.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule.
 4. Combined Contractor's construction schedule incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Sustainable design action plans, including preliminary project materials cost data.
 7. Schedule of unit prices.
 8. Submittal schedule (preliminary if not final).
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.
 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Initial progress report.
 14. Report of preconstruction conference.
 15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.
 18. Any other documents required by the Contract Documents.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

- a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 10. Final liquidated damages settlement statement.
 11. Proof that taxes, fees, and similar obligations are paid.
 12. Waivers and releases.
 13. Any other documents required by the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

- B. Key Personnel Names: As soon as practicable after the award of the Contract, but no more than 15 days, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

- a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
- b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
- c. Indicate functional and spatial relationships of components of architectural, structural, mechanical, and electrical systems.
- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
- e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
- f. Indicate required installation sequences.
- g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
3. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
4. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
5. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
6. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.

7. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 8. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 9. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
- C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
 3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
 4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 6. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
- D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 - b. DWG, operating in Microsoft Windows operating system.
 2. File Submittal Format: Submit or post coordination drawing files using PDF format.
 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in AutoCad MEP 2018.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.
 3. Owner's Project number.
 4. Name of Architect.
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.

- d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
- 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 - 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include no less than the following:
- 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number, including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's CAD drawings will be provided by Architect for Contractor's use during construction.
- 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
 - 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 - 3. Digital Drawing Software Program: Contract Drawings are available in AutoCad MEP 2018.
 - 4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

- a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.
- 5. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.

- i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Distribution of the Contract Documents.
 - l. Submittal procedures.
 - m. Sustainable design requirements.
 - n. Preparation of Record Documents.
 - o. Use of the premises and existing building.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.

- p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 14 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for completing sustainable design documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Coordination of separate contracts.
 - l. Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of RFIs.
 - 15) Proposal Requests.
 - 16) Change Orders.
 - 17) Pending changes.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Site condition reports.
 - 5. Unusual event reports.
- B. Related Requirements:
 - 1. Section 014000 "Quality Requirements" for schedule of tests and inspections.
 - 2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float in the construction schedule and any update to it shall belong to the Owner.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
- B. Startup construction schedule.
 - 1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.

- G. Unusual Event Reports: Submit at time of unusual event.
- H. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

1.6 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice of Award to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 5. Startup and Testing Time: Include no fewer than 7 days for startup and testing.
 6. Commissioning Time: Include no fewer than 7 days for commissioning.
 7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 8. Punch List and Final Completion: Include not more than 7 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Use-of-premises restrictions.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Fabrication.
 - e. Sample testing.
 - f. Deliveries.
 - g. Installation.
 - h. Tests and inspections.
 - i. Adjusting.
 - j. Startup and placement into final use and operation.
 - k. Commissioning.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Completion of demolition.
 - b. Completion of mechanical installation.
 - c. Completion of electrical installation.
 - d. Substantial Completion.

- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

- F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

- G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.

- H. Contractor's Construction Schedule Updating: At two week intervals, update schedule to reflect actual construction progress and activities. Issue schedule 2 days before each regularly scheduled progress meeting.
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Final Completion percentage for each activity.

- I. Recovery Schedule: When periodic update indicates the Work is 7 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

- J. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 1. Post copies in Project meeting rooms and temporary field offices.

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

1.8 STARTUP CONSTRUCTION SCHEDULE

- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for commencement of the Work.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 40 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 CONSTRUCTION SCHEDULE TYPE

- A. At the contractor's option, the construction schedule shall be either a Gantt-chart type or CPM type.

1.10 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 10 days after the Effective Date.
 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.11 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 7 days of date established for the Notice of Award. Outline significant construction activities for the first 14 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
 1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 10 days after the Effective Date.

- a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and Final Completion.
 - l. Activities occurring following Final Completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.

- a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.

- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Main events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Average size of workforce.
 - 10. Dollar value of activity (coordinated with the schedule of values).

- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.

- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 - 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 - 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 - 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 - 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.12 REPORTS

- A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- B. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
 - 1. Submit unusual event reports directly to Owner and the Architect within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Administrative and procedural requirements for submittals.

- B. Related Requirements:

- 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list.
 - 3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 6. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 7. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal and by noting all deviations on attached separate sheet placed near the front of the submittal.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted. Transmit in PDF file format.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- D. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of

assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

E. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

F. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.

- d. Product and manufacturers' names.
- e. Description of product.
- f. Test procedures and results.
- g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.

- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will discard submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 013516 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes special procedures for alteration work.

1.3 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep existing items that are not to be removed or dismantled.

- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.4 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
 - 1. Schedule construction operations in sequence required to obtain best Work results.
 - 2. Coordinate sequence of alteration work activities to accommodate the following:
 - a. Owner's continuing occupancy of portions of existing building.
 - b. Other known work in progress.
 - c. Tests and inspections.
 - 3. Detail sequence of alteration work, with start and end dates.
 - 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
 - 5. Use of elevator and stairs.
 - 6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns and adjacent to restricted areas. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

1.5 INFORMATIONAL SUBMITTALS

- A. Alteration Work Subschedule:
 - 1. Submit alteration work subschedule with primary construction schedule.
- B. Alteration Work Program: Submit 30 days before work begins.
- C. Fire-Prevention Plan: Submit 30 days before work begins.

1.6 QUALITY ASSURANCE

- A. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.

- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
 - 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 - 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
 - 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 - 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area off-site.
 - 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
 - 1. Repair and clean items for reuse as indicated.
 - 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
2. Secure stored materials to protect from theft.
3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F or more above the dew point.

E. Storage Space:

1. Owner will arrange for limited on-site location(s) for free storage of salvaged material. This storage space includes security for stored material.
2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.

1.8 FIELD CONDITIONS

- A. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- B. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
 1. Use only proven protection methods, appropriate to each area and surface being protected.
 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 3. Erect temporary barriers to form and maintain fire-egress routes.
 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.

- B. Temporary Protection of Materials to Remain:
 - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
 - 1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 - 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
 - 1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
 - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection.

3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
 - 1. Comply with NFPA 241 requirements unless otherwise indicated. Perform duties titled "Owner's Responsibility for Fire Protection."
 - 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: While performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using

high heat or combustible solvents and chemicals are anticipated, the contractor shall take special precautions to protect the portions of the building that may be affected by excessive heat.

1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
 2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire-watch personnel at each area of Project site until 60 minutes after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.

- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- D. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 013516

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."
- H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting

requirements that are different, but apparently equal, to Architect for clarification before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Contractor's quality-control personnel.
- B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- E. Reports: Prepare and submit certified written reports and documents as specified.
- F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, telephone number, and email address of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged in the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
1. Provide test specimens representative of proposed products and construction.
 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 3. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

1.9 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- C. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
 2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections attached to this Section, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas

and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000



Statement of Special Inspections

State CPA No.: _____
Project Name: Coshocton Public Library
Project Location: 655 Main Street, Coshocton, Ohio, 43812

Pursuant to section 1704.3 Ohio Building Code, this statement of special inspections must be prepared by the registered design professional in responsible charge acting as the owner’s agent. This statement (2-part documents) should be submitted as a condition for plan approval and should include the following:

- **Part I:** A complete list of materials and work requiring special inspections and the required frequency of inspections by sections 1705.1 through 1705.18 Ohio Building Code.
- **Part II:** A list of special inspectors who are qualified and are competent to the particular type of construction or operations. **These special inspectors shall be employed by the owner or by the owner’s representative, other than the contractor. Submit proper resumes and/or certificates of the special inspectors.**

** Please mark “X” on all work items requiring special inspection and the required frequency of inspections for this project per requirements in section 1705 OBC.

| PART I: SCHEDULE OF SPECIAL INSPECTIONS | | | | |
|---|--|-------|-----------------------|---------------------|
| No. | ITEM | Req’d | Continuous Inspection | Periodic Inspection |
| 1 | Special Cases (1705.1 OBC) | | | |
| 2 | Steel Construction (1705.2 OBC) | X | | X |
| 3 | Concrete Construction (1705.3 OBC) | | | |
| 4 | Masonry Construction (1705.4 OBC) | | | |
| 5 | Wood Construction (1705.5 OBC) | | | |
| 6 | Soil Conditions (1705.6 OBC) | | | |
| 7 | Driven Deep Foundations (1705.7 OBC) | | | |
| 8 | Cast-in-place Deep Foundation (1705.8 OBC) | | | |
| 9 | Helical Pile Foundation (1705.9 OBC) | | | |
| 10 | Fabricated Items (1705.10 OBC) | X | | X |
| 11 | Wind Resistance (1705.11 OBC) | | | |
| 12 | Seismic Resistance (1705.12 OBC) | | | |
| 13 | Testing for Seismic Resistance (1705.13 OBC) | | | |
| 14 | Sprayed Fire Resistant Materials (1705.14 OBC) | | | |
| 15 | Mastic & Intumescent Coatings (1705.15 OBC) | | | |
| 16 | EIFS Systems (1705.16 OBC) | | | |

| | | | | |
|----|---|--|--|--|
| 17 | Fire Resistant Penetrations & Joints (1705.17 OBC) | | | |
| 18 | Smoke Control System (1705.18 OBC) | | | |

- Submit the resume of special inspectors for all marked special inspection items in the part I table showing the qualification and/or special training per 1704.2.1 OBC.

| PART II: LIST OF SPECIAL INSPECTORS | | | |
|-------------------------------------|---|--------------------|-------------------|
| No. | ITEM | Inspection Company | Name of Inspector |
| 1 | Special Cases (1705.1 OBC) | | |
| 2 | Steel Construction (1705.2 OBC) | | |
| 3 | Concrete construction (1705.3 OBC) | | |
| 4 | Masonry Construction (1705.4OBC) | | |
| 5 | Wood Construction (1705.5 OBC) | | |
| 6 | Soils (1705.6OBC) | | |
| 7 | Driven Deep Foundation (1705.7OBC) | | |
| 8 | Cast-In-Place Deep Foundation (1705.8 OBC) | | |
| 9 | Helical Pile Foundation (1705.9 OBC) | | |
| 10 | Fabricated Items (1705.10 OBC) | | |
| 11 | Wind Resistance (1705.11 OBC) | | |

| | | | |
|----|--|--|--|
| 12 | Seismic Resistance (1705.12 OBC) | | |
| 13 | Testing for Wind Resistance (1705.13 OBC) | | |
| 14 | Sprayed Fire-Resistant Materials (1705.14 OBC) | | |
| 15 | Mastic & Intumescent Fire Resistant Coatings (1705.15 OBC) | | |
| 16 | Exterior Insulation & Finish System (EIFS) (1705.16 OBC) | | |
| 17 | Fire-Resistant Penetrations & Joints (1705.17 OBC) | | |
| 18 | Smoke Control System (1705.18 OBC) | | |

The project registered design professional acknowledges the responsibility of reviewing and approving the special inspection reports submitted by the special inspectors at the required inspection periods. Any discrepancies in special inspection reports shall be reported to the building official. A final special inspection report documenting required special inspections and corrections of any discrepancies noted in the inspections shall be submitted to the building official.

Statement certified by:

Name of Designer: Alice M. Hogan **Registration No.** PE70429

Name of Company: H.F. Lenz Company

Designer Signature: _____ **Date** _____

Name of Owner: _____ **Company** _____

Owner Signature: _____ **Date** _____

(Revised 04-23-2018)

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "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.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "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."
- E. "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.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
 - 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 11. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 12. AGA - American Gas Association; www.aga.org.
 - 13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 - 14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 15. AI - Asphalt Institute; www.asphaltinstitute.org.
 - 16. AIA - American Institute of Architects (The); www.aia.org.
 - 17. AISC - American Institute of Steel Construction; www.aisc.org.
 - 18. AISI - American Iron and Steel Institute; www.steel.org.
 - 19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 - 20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.

21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASSP - American Society of Safety Professionals (The); www.assp.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AVIXA - Audiovisual and Integrated Experience Association; (Formerly: Infocomm International); www.soundandcommunications.com.
38. AWEA - American Wind Energy Association; www.awea.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
50. CDA - Copper Development Association; www.copper.org.
51. CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>.
52. CEA - Canadian Electricity Association; www.electricity.ca.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.compositepanel.org.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.

64. CSA - CSA Group; www.csa-group.org.
65. CSI - Construction Specifications Institute (The); www.csiresources.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTA - Consumer Technology Association; www.cta.tech.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.coolingtechnology.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHA - Decorative Hardwoods Association; (Formerly: Hardwood Plywood & Veneer Association); www.decorativehardwoods.org.
72. DHI - Door and Hardware Institute; www.dhi.org.
73. ECA - Electronic Components Association; (See ECIA).
74. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
75. ECIA - Electronic Components Industry Association; www.eciaonline.org.
76. EIA - Electronic Industries Alliance; (See TIA).
77. EIMA - EIFS Industry Members Association; www.eima.com.
78. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
79. EOS/ESD Association; (Electrostatic Discharge Association); www.esda.org.
80. ESTA - Entertainment Services and Technology Association; (See PLASA).
81. ETL - Intertek (See Intertek); www.intertek.com.
82. EVO - Efficiency Valuation Organization; www.evo-world.org.
83. FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.
84. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
85. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
86. FM Approvals - FM Approvals LLC; www.fmglobal.com.
87. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
88. FRSA - Florida Roofing, Sheet Metal Contractors Association, Inc.; www.floridarooft.com.
89. FSA - Fluid Sealing Association; www.fluidsealing.com.
90. FSC - Forest Stewardship Council U.S.; www.fscus.org.
91. GA - Gypsum Association; www.gypsum.org.
92. GANA - Glass Association of North America; (See NGA).
93. GS - Green Seal; www.greenseal.org.
94. HI - Hydraulic Institute; www.pumps.org.
95. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
96. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
97. HPVA - Hardwood Plywood & Veneer Association; (See DHA).
98. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
99. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
100. IAS - International Accreditation Service; www.iasonline.org.
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.

108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
113. II - Infocomm International; (See AVIXA).
114. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
115. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
116. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
117. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
118. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
119. ISO - International Organization for Standardization; www.iso.org.
120. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
121. ITU - International Telecommunication Union; www.itu.int/home.
122. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
123. LMA - Laminating Materials Association; (See CPA).
124. LPI - Lightning Protection Institute; www.lightning.org.
125. MBMA - Metal Building Manufacturers Association; www.mbma.com.
126. MCA - Metal Construction Association; www.metalconstruction.org.
127. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
128. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
129. MHIA - Material Handling Industry of America; www.mhia.org.
130. MIA - Marble Institute of America; (See NSI).
131. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
132. MPI - Master Painters Institute; www.paintinfo.com.
133. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
134. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
135. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
136. NADCA - National Air Duct Cleaners Association; www.nadca.com.
137. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
138. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
139. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
140. NBI - New Buildings Institute; www.newbuildings.org.
141. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
142. NCMA - National Concrete Masonry Association; www.ncma.org.
143. NEBB - National Environmental Balancing Bureau; www.nebb.org.
144. NECA - National Electrical Contractors Association; www.necanet.org.
145. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
146. NEMA - National Electrical Manufacturers Association; www.nema.org.
147. NETA - InterNational Electrical Testing Association; www.netaworld.org.
148. NFHS - National Federation of State High School Associations; www.nfhs.org.
149. NFPA - National Fire Protection Association; www.nfpa.org.

150. NFPA - NFPA International; (See NFPA).
151. NFRC - National Fenestration Rating Council; www.nfrc.org.
152. NGA - National Glass Association (The); (Formerly: Glass Association of North America); www.glass.org.
153. NHLA - National Hardwood Lumber Association; www.nhla.com.
154. NLGA - National Lumber Grades Authority; www.nlga.org.
155. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
156. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
157. NRCA - National Roofing Contractors Association; www.nrca.net.
158. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
159. NSF - NSF International; www.nsf.org.
160. NSI - National Stone Institute; (Formerly: Marble Institute of America); www.naturalstoneinstitute.org.
161. NSPE - National Society of Professional Engineers; www.nspe.org.
162. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
163. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
164. NWFA - National Wood Flooring Association; www.nwfa.org.
165. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
166. PDI - Plumbing & Drainage Institute; www.pdionline.org.
167. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
168. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
169. RFCI - Resilient Floor Covering Institute; www.rfci.com.
170. RIS - Redwood Inspection Service; www.redwoodinspection.com.
171. SAE - SAE International; www.sae.org.
172. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
173. SDI - Steel Deck Institute; www.sdi.org.
174. SDI - Steel Door Institute; www.steeldoor.org.
175. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
176. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
177. SIA - Security Industry Association; www.siaonline.org.
178. SJI - Steel Joist Institute; www.steeljoist.org.
179. SMA - Screen Manufacturers Association; www.smainfo.org.
180. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
181. SMPTE - Society of Motion Picture and Television Engineers; www.smpete.org.
182. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
183. SPIB - Southern Pine Inspection Bureau; www.spib.org.
184. SPRI - Single Ply Roofing Industry; www.spri.org.
185. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
186. SSINA - Specialty Steel Industry of North America; www.ssina.com.
187. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
188. STI - Steel Tank Institute; www.steeltank.com.
189. SWI - Steel Window Institute; www.steelwindows.com.
190. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
191. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
192. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
193. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.

194. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
195. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
196. TMS - The Masonry Society; www.masonrysociety.org.
197. TPI - Truss Plate Institute; www.tpinst.org.
198. TPI - Turfgrass Producers International; www.turfgrasssod.org.
199. TRI - Tile Roofing Institute; www.tilerroofing.org.
200. UL - Underwriters Laboratories Inc.; www.ul.com.
201. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
202. USAV - USA Volleyball; www.usavolleyball.org.
203. USGBC - U.S. Green Building Council; www.usgbc.org.
204. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
205. WA - Wallcoverings Association; www.wallcoverings.org.
206. WASTEC - Waste Equipment Technology Association; www.wastec.org.
207. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
208. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
209. WDMA - Window & Door Manufacturers Association; www.wdma.com.
210. WI - Woodwork Institute; www.wicnet.org.
211. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.

13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.govinfo.gov.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.

7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development;
www.txforests.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- C. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste-handling procedures.
 - 5. Other dust-control measures.
- D. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
 - 1. Methods used to meet the goals and requirements of the Owner.
 - 2. Concrete cutting method(s) to be used.
 - 3. Location of construction devices on the site.
 - 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 - 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
 - 6. Indicate locations of sensitive research or equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.
- B. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.
- C. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices: Owner will provide interior space for field offices for duration of Project. No telephone or internet service will be provided by the Owner. Contractor shall provide his own communication services and desks/ tables.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.
- D. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
1. Utilize designated area within existing building for temporary field offices.
 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Parking: Use the parking lot directly behind the library at the intersection of S. 7th and Walnut Streets for construction personnel. The Contractor is limited to ten (10) total spaces as selected by the Owner for parking and storage / staging. No overnight vehicle parking is permitted.
- C. Storage and Staging: Use the parking lot directly behind the library at the intersection of South 7th and Walnut Streets for storage and staging needs. The Contractor is limited to ten (10) total spaces as selected by the Owner for parking and storage / staging.
1. Storage shall be in secured containers. The Contractor is responsible for security. No fencing may be erected.
 2. The Contractor may also use limited storage areas within the library, as directed by library personnel, for limited equipment. The storage shall not block service and maintenance access to existing equipment and systems to remain.
- D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
1. Permitted Location of Contractor's Dumpster: A single 40 cubic yard dumpster may be located in the rear library parking lot, while keeping the loading dock accessible for deliveries.
- E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

- F. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- G. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- C. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- D. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- E. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard, with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.

2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 3. Section 014200 "References" for applicable industry standards for products specified.
 - 4. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

- B. **Basis-of-Design Product Specification:** A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. **Evaluation of Comparable Products:** In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

- C. **Subject to Compliance with Requirements:** Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

- D. **Comparable Product Request Submittal:** An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

- E. **Basis-of-Design Product Specification Submittal:** An action submittal complying with requirements in Section 013300 "Submittal Procedures."

- F. **Substitution:** Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

- A. **Compatibility of Options:** If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. **Resolution of Compatibility Disputes between Multiple Contractors:**
 - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.

- b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

- a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
- 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
- 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
- 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
- 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
 - 1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
 - 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 - 3. Evidence that proposed product provides specified warranty.
 - 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 - 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
 - 1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Installation of the Work.
3. Cutting and patching.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.

- B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products, and limits on use of Project site.
2. Section 017700 "Closeout Procedures" for replacing defective work and final cleaning.
3. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the existing work.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Electrical wiring systems.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Sprayed fire-resistive material.
 - d. Equipment supports.
 - e. Piping, ductwork, vessels, and equipment.
 - f. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.
- D. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

E. Recycling: Recycle demolished and construction waste materials of the following types:

1. Metals (all types)
2. Cardboard.
3. Paper.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 80 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.
 - J. Repair or remove and replace damaged, defective, or nonconforming Work.
 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel.
 - 1. Provide temporary facilities required for Owner-furnished, Contractor-installed products.
 - 2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed products
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials

specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

- C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 4. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit sustainable design submittals not previously submitted.
 - 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
 2. Complete startup and testing of systems and equipment.
 3. Perform preventive maintenance on equipment used prior to Substantial Completion.
 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 5. Terminate and remove temporary facilities from Project site, along with construction tools and similar elements.
 6. Complete final cleaning requirements.
 7. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
 5. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF Electronic File: Architect will return annotated file.

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
1. Submit by email to Architect and Owner.
- D. Warranties in Paper Form:
1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.

- j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- l. Remove labels that are not permanent.
- m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

- p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- q. Clean strainers.
- r. Leave Project clean and ready for occupancy.

- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit one paper copy. Architect will return no copies.
 - 2. After receiving review comments from Architect, provide two updated copies to the Owner.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

- b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
- 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
- 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
- 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
- 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Architect.
 - 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.

7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.

5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Product Data.
 - 3. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Submit one paper-copy set(s) of marked-up record prints.
 - b. Submit Record Digital Data Files and one set of Record Digital Data File plots.
 - 1) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction] Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.

2. Format: Autocad MEP 2018 DWG,, Microsoft Windows operating system.
 3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 4. Refer instances of uncertainty to Architect for resolution.
 5. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data.
 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file or scanned PDF electronic file(s) of marked-up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 COORDINATION

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

1.5 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.

2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.

5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.

7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.

8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.6 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.7 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 2. Owner will furnish an instructor to describe Owner's operational philosophy.

3. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017900

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 1. In the event of a direct conflict with the requirements of this Section and of those contained in Divisions 01, 02, 03, 05, 07, 09, the requirements of those other Divisions shall take precedence, but only if they are more demanding or restrictive.

1.2 SUMMARY

- A. This Section includes provisions that apply to Division 23 work in its entirety.
- B. This Section includes the following:
 - 1. General Project Requirements
 - a. Definitions
 - b. General Project Coordination and Planning
 - 1) Coordination between Division 23 and Division 26
 - 2) Coordination with the Commissioning Agent
 - c. HVAC System Commissioning
 - d. Owner Instruction
 - e. Delivery, Storage, and Handling
 - f. Sequencing and Scheduling
 - g. Temporary Shutdown of Existing Systems
 - h. Pre-Bid Site Visits
 - i. Interpretation of the Documents
 - j. Basis of Design Products and Substitutions
 - k. Submittals - General Requirements
 - l. Warranties
 - 2. Coordination Drawings
 - 3. Extra Materials
 - 4. Piping materials and installation instructions common to most piping systems
 - 5. Fire- and smoke-stopping materials and systems
 - 6. Materials used in air plenums.
 - 7. Field-fabricated metal equipment supports
 - 8. Equipment installation requirements common to equipment specification sections

9. Coordination of communications between factory mounted equipment controls and the building automation system
10. Motor controllers and disconnect switches
11. Construction during occupancy
12. HVAC demolition
13. Cutting and patching
14. Installation of work on the roof
15. Cleaning and protection
16. Installation of pre-purchased equipment
17. Painting and finishing
18. AC condensate drain piping
19. Rooftop access crossovers

1.3 DEFINITIONS

- A. Atmosphere: Outside the exterior walls and roof of a building.
- B. Finished Spaces: Areas where drywall is hung or installed with wall coverings and/or painted; or where floors are polished or coverings are installed on the floor; or where the ceiling is plaster/gypsum board and/or suspended acoustic ceiling tile.
- C. Unfinished Space: Spaces other than finished spaces. Typical examples include mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, attics, crawl spaces, garages, and tunnels.
- D. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- E. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- F. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- G. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters or inside equipment enclosures.
- H. Conditioned Space: Spaces within the insulated envelope of the building and provided with both mechanical heating and air conditioning, either directly or indirectly.
 1. Ceiling and floor plenums and ceiling spaces (areas between the finished ceiling and the structural floor or roof slab/deck above) are considered (indirectly) conditioned spaces.
- I. Unconditioned Space: Spaces lacking either mechanical heating or air conditioning, or both, and are outside of the insulated envelope of the building. Examples: Outdoor-air-ventilated crawlspaces and attics.

1. Mechanical and electrical rooms, and similar spaces, that are only heated and outdoor-air-ventilated, or are only outdoor-air-ventilated, shall be considered unconditioned spaces.
- J. Contractor: The contractor performing the work of the trade drawings or specification division where the use of the term appears, unless a more specific indication is made.
- K. Furnish: Purchase and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar subsequent requirements.
- L. Install: Operations at project site required to place furnished materials and equipment into use, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, connecting, finishing, curing, protecting, cleaning, adjusting, commissioning, and similar requirements.
- M. Provide: Both furnish and install.
- N. Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Install items in the same locations or in locations indicated.
- O. Relocate: Same meaning as "reinstall".
- P. Remove: Remove items from their current installed condition and legally dispose of those items, except those indicated to be reinstalled/relocated or salvaged or to remain the Owner's property as indicated.
- Q. Demolish: Same meaning as "remove".
- R. Replace: Remove items indicated as defined under "remove" herein and provide new items with matching dimensions, capacities, and all other features in the same location as the items removed, unless explicitly indicated otherwise.
- S. Salvage (and similar terms and phrases such as "Turn Over to Owner"): Items indicated to be salvaged shall remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
- T. Indicated: The term "indicated", "shown," "noted," "scheduled," and "specified" refers to graphic representations, notes, schedules, or other indications on the Drawings; or to other paragraphs or schedules in the Specifications and other similar requirements in the Contract Documents.
- U. May: Indicative of a Contractor's Option, or that which the Contractor is permitted to do, but not required to do.
- V. Shall: Indicative of a mandatory contract requirement, or that which the Contractor has a duty to perform.
- W. Must: Same meaning as "shall".
- X. Will: Unless explicitly identified as associated with the work of, or performed by, another contractor or under a separate contract, or to be future work also outside this contract, "will" shall

be taken to mean the same as "shall", (i.e. representative of a mandatory requirement of this contract).

- Y. The terms "approved", "equal", "acceptable", or "proper" and words of a similar meaning shall be understood to mean "meeting the design intent as determined by the Architect or Engineer".
- Z. The terms "Engineer" and "Architect" used in these specifications are used interchangeably, and refer to the same entities - the design professionals of record.
- AA. "Approved": When used to convey Architect's or Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's or Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- BB. "Directed": A command or instruction by Architect or Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- CC. "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."
- DD. References to "GC", "General Contractor" shall refer to the Contractor.
- EE. References to "HC", "Heating Contractor", "HVAC Contractor", and "Mechanical Contractor" on the drawings depicting the HVAC system work shall refer to the Contractor performing the work of Division 23.
- FF. References to "PC", "Plumbing Contractor" shall refer to the Contractor performing the work of Division 22.
- GG. References to "FC", "FPC", "Sprinkler Contractor", and "Fire Protection Contractor" shall refer to the Contractor performing the work of Division 21.
- HH. References to "EC" and "Electrical Contractor" on the drawings depicting the HVAC system work shall refer to the Contractor performing the work of Divisions 26, 27, and 28.
- II. Withstand, Resist: With respect to wind resistance ratings, "withstand" and "resist" shall mean to be without permanent deformation of components, fasteners and anchors, and be able to continue to function normally without excessive water or air leakage, without excessive vibration, and meeting all scheduled functional performance requirements, after being subjected to the design wind speed from any direction.
- JJ. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

- A. Product Data: Provide for the following:
 - 1. Rooftop access crossovers and service platforms
 - 2. Fire- and smoke-stopping materials
- B. Shop Drawings: Detail fabrication and installation for metal supports and anchorage for HVAC materials and equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Coordination drawings shall be prepared as specified in this Section and as defined in Division 01. Note that the requirements of this Section may be more restrictive and create additional requirements.
 - 1. Refer to the coordination article(s) elsewhere in this Section.
 - 2. No installation of permanent systems shall proceed until the coordination drawings are reviewed by the Architect / Engineer. No additional compensation shall be allowed for changes required to accommodate installation of systems provided under other Divisions of this Contract.
 - 3. Coordination drawings shall be developed from individual system shop drawings and contractor fabrication drawings. Electronic or other reproduced engineering design drawings used as coordination drawings are not acceptable.
 - 4. Coordination drawings shall be initiated by the Contractor responsible for the ductwork installation. That Contractor shall indicate, on the plans, equipment and duct locations and dimensions drawn to scale, taking into consideration and incorporating proper service and access clearances. The drawing shall then be given to the Contractors installing piping, conduit for the inclusion of their work on the coordination drawing. All discrepancies and conflicts with the architectural layout of the building shall be noted on the coordination drawings. The Contractors of the various Divisions shall meet as required to resolve discrepancies with ductwork, piping, and conduit prior and to coordinate those elements on the coordination drawings. The Contractor who initiated the coordination drawings shall submit them for review to the Architect and Engineer. Coordination and installation of work not indicated on the coordination drawing shall be the responsibility of the Contractor responsible for that equipment. Any modifications required by any Contractor for equipment to be installed that is not shown on the coordination drawing shall be the responsibility of the Contractor who failed to indicate that equipment.
 - a. Coordination drawings shall be prepared for each general area, floor level, and roof level and shall be of a scale not less than 1/4 inch per 1 foot. Mechanical and electrical rooms and areas with similar levels of congestion shall be prepared at 1/2 inch per foot.
 - b. Plans and elevations shall be prepared for shafts and chases containing more than one duct or the work of multiple trades at 1/4" per foot.
 - c. Electronic Format: As required by Division 01.
 - 5. Detail major elements, components, and systems of HVAC equipment and materials in relationship with other systems, installations, and building components. Show space

requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

- a. Planned ductwork layout, including all duct accessories (dampers, silencers, access doors, etc.) and control devices (airflow measuring stations, sensors, etc.).
 - b. Planned piping layout, including valve and specialty locations, meters and gauges, control devices (control valves, flow meters, sensors, etc.), and valve-stem movement.
 - c. Clearances for installing and maintaining insulation.
 - d. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - e. Hangers and supports for ductwork, piping, and equipment, including the size and magnitude of all point loads.
 - f. Access paths through mechanical rooms and on roofs.
 - g. Methods for maintaining required roof slope and roof drainage around rooftop installations.
 - h. Equipment and accessory service connections and support details.
 - i. Sizes and locations of access panels in ceilings, shafts, walls, etc.
 - j. Exterior wall and foundation penetrations.
 - k. Fire- and smoke-rated wall and floor penetrations. Indicate UL directory file number for the fire/smoke stopping system proposed at each penetration.
 - l. Sizes and location of required concrete pads and bases.
 - m. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - n. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - o. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.
 - p. Requirements for coordination drawings indicated in other Division 23 Sections.
6. Access Panel Schedule: List of sizes, types, locations, and required purpose for all access panels in ceilings, shafts, walls, etc. Coordinate locations of any access panels not indicated on the Architectural Drawings with the Architect prior to installation.

1.6 CLOSEOUT INFORMATIONAL SUBMITTALS

- A. Electronic Files: Provide electronic files of all ductwork and piping shop drawings in an electronic format as specified in Division 01.
 1. Files shall be submitted on DVDs or flash memory drives (drives will not be returned to the Contractor), unless Division 01 stipulates otherwise.
 2. Also include one (1) hard copy set of all drawings. If shop drawings included color coding, the hard copy shall also be in color.
- B. Operations and Maintenance Manuals: Comply with requirements in Division 01 and requirements detailed elsewhere in other Division 23 Sections. Manuals shall be provided no later than 90 days after Substantial Completion, unless an earlier date is required by Division 01. O&M manuals for Division 23 work shall also include the following:

1. Copies of manufacturer's operation and maintenance manuals for each piece of equipment provided under this Project. Required routine maintenance actions shall be clearly identified.
2. Parts and material lists, including contact information for product representative or other place to purchase.
3. List of normally replaced items, such as filters, fuses, belts, seals, gaskets, etc., indicating style, rating, size, etc., and contact information for product representative or other place to purchase.
4. Installation, servicing, maintenance, and operating instructions for all systems and components with the place of original purchase and name and contract information of the person who can service the system.
5. System and equipment startup, seasonal changeover, and seasonal shutdown with prestart checklists and precautions.
6. System and equipment troubleshooting guides.
7. Copies of manufacturers' and Contractor's guarantees and warranties.
8. Copies of approved submittals incorporating all comments and corrections noted during the final engineer review and reflecting field changes to systems and equipment:
 - a. Product data and shop drawings for all equipment.
 - b. Final, approved balancing report(s).
 - c. ATC product data and shop drawings, including component wiring diagrams, ATC wiring diagrams.
9. Schedule of all motors, starters, and controllers under this Division with the following information included:
 - a. Location
 - b. All nameplate data
 - c. Overload rating and manufacturer's number
 - d. Actual full-load amperes
 - e. Overcurrent protection
10. Copies of all inspection certificates and approvals from all inspection agencies.

1.7 EXTRA MATERIALS

- A. Unless otherwise specified, extra materials (e.g. maintenance material submittals), wherever required by other Division 23 Sections, shall be stored in accordance with the provisions of this paragraph.
 1. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate).
 2. Include copies of relevant installation and operating manuals and contact information for the supplier. Documentation shall be placed in the packaging / storage box.
 3. Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in sealed plastic wrapping.

4. Spare parts with individual weights less than 5 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be furnished in cardboard boxes. A neatly type inventory of spare parts shall be placed in a plastic sleeve and taped to the outside of the box.

1.8 QUALITY ASSURANCE

- A. Code Compliance: All aspects of the Contractor's work shall comply with applicable codes.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Factory Fabricated HVAC Equipment: Of the type, design, and size that manufacturers currently offer for sale and appears in the manufacturer's current catalogue. Equipment shall be new and fabricated from new materials, and shall be free from defects in materials and workmanship.
- D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- E. Minimum Energy Efficiency: Compressor-containing, fuel fired, and absorption refrigeration equipment shall meet the minimum efficiency requirements listed in the 2017 Ohio Energy Code and ASHRAE 90.1-2010.

1.9 GENERAL PROJECT COORDINATION AND PLANNING

- A. Prior to the ordering of materials or installation of work, coordinate and pre-plan the work to the extent necessary to permit the work to be installed satisfactorily, in accordance with the Contract Documents, and with the least possible interference or delay.
- B. When work is installed without the required coordination and/or planning, changes to the work deemed necessary by the Architect shall be made to correct the conditions without additional cost to the Owner.
- C. The Contractor is advised to furnish complete Contract Documents to all suppliers, sub-contractors, and other agents. Information required by those entities for the proper completion of their work in a coordinated fashion with the work of others will typically appear in multiple places in the Contract Documents.
 1. Any failure on the part of a suppliers, sub-contractors, and other agents to improperly interpret the Contractor Documents or to understand other requirements made necessary by the coordination and planning process, is the full responsibility of the Contractor.

1.10 HVAC SYSTEM COMMISSIONING

- A. All HVAC systems provided by this project shall be commissioned in accordance with the **2017 Ohio Energy Code**. Refer to Division 23 Section "Commissioning for HVAC".
 - 1. The services of the Commissioning Agent shall be retained by the Division 23 Contractor.
- B. The Division 23 Contractor shall assist the Commissioning Agent by supporting tasks as directed by the Agent.
- C. The Division 23 Contractor shall perform their own functional testing and commissioning of the systems as elsewhere detailed in the Division 23 Specifications to verify that the systems are installed in full accordance with the documents and the requirements of the equipment manufacturers, as applicable, prior to the start of work by the Commissioning Agent.

1.11 COORDINATION WITH THE OWNER HIRED COMMISSIONING AGENT

- A. A Commissioning Agent will be hired by the Owner for system certification at the completion of construction. The Division 23 Contractor shall assist the Commissioning Agent by supporting tasks as directed by the Agent.
- B. Refer to Division 01.
- C. The Division 23 Contractor shall perform their own functional testing and commissioning of the systems as elsewhere detailed in the Division 23 Specifications to verify that the systems are installed in full accordance with the documents and the requirements of the equipment manufacturers, as applicable, prior to the start of work by the Commissioning Agent.

1.12 OWNER INSTRUCTION

- A. Comply with the demonstration and instruction requirements indicated in other Division 23 Sections.
- B. Instruction Time: Some Division 23 specification Sections indicate a minimum allowance for instruction time. The length of instruction time will be measured by actual time spent performing demonstration and training in required location. Time spent assembling educational materials, setting up, or cleaning up shall be counted against the time allotment.
- C. Operations and Maintenance Manuals shall be distributed to the Owner no less than one (1) week prior to the instruction periods unless Division 01 stipulates a greater length of time.
- D. Forward to the Architect / Engineer the signatures of all those who attended the instruction sessions.
- E. Refer to Division 01 for additional Owner instruction requirements.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 - 2. Store products to allow for inspection and measurement of quantity or counting of units.
 - 3. Store materials in a manner that will not endanger Project structure.
 - 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.
- D. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- F. Protect flanges, fittings, and piping specialties from moisture and dirt.
- G. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.14 SEQUENCING AND SCHEDULING

- A. Coordinate HVAC equipment and systems installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for HVAC installations.

- C. Coordinate installation of required supporting devices and set sleeves in structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring.
- E. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if HVAC items such as dampers, valves and other equipment requiring access are concealed behind finished surfaces where no other means of access is available. Provide access panels and doors meeting the applicable requirements of Division 08. Coordinate locations of any access panels not indicated on the Architectural Drawings with the Architect prior to installation.

1.15 TEMPORARY SHUTDOWN OF EXISTING SYSTEMS

- A. Plan installation of new work and connections to existing work to insure minimum interference with regular operation of existing systems. Some temporary shutdown of existing systems may be required to complete the work.
- B. Submit to the Owner in writing for approval, proposed date schedule, time, and duration of necessary temporary shutdowns of existing systems. Submit schedule at least ten (10) working days (exclusive of holidays and weekends) in advance of intended shutdown or as indicated in Division 01, whichever is longer. Shutdowns shall be made at such times as shall not interfere with regular operation of existing facilities and only after written approval of Owner. The Owner reserves the right to cancel shutdowns at any time prior to the shutdowns. To minimize conflict with Owner's operation, shutdowns shall be planned to occur on weekends. To insure continuous operation, make necessary temporary connections between new and existing work. The Contractor shall bear costs resulting from temporary shutdowns and temporary connections. No additional charges shall be allowed for Owner-canceled shutdowns that must be rescheduled.
- C. To minimize conflict with Owner's operation, shutdowns shall be planned to occur on weekends between 3:00 p.m. and 11:00 p.m., except fire alarm and fire protection system shutdowns, which shall occur on weekdays between 9:00 a.m. and 4:00 p.m. as approved by the Owner.
- D. Refer to Division 01 for additional requirements.

1.16 INTENT AND REQUIRED INTERPRETATION OF THE CONSTRUCTION DOCUMENTS

- A. Refer to the Article titled "Basis of Design Products and Substitutions" located elsewhere in this Section.
- B. Provide complete and functional systems for the project. The systems shall conform to the details stated in these Specifications and shown on the Drawings. Items or work not shown or specified, but required for complete systems, shall be provided and conform to accepted trade practices.

- C. The Drawings and Specifications are presented to define specific system requirements and serve to expand on the primary contract requirements of providing complete and functional systems. The drawings are diagrammatic and indicate the general arrangement and routing of the systems included in this Contractor's work.
- D. Drawings and Specifications are intended to be complementary to each other, and contract required work only may be indicated in one of these two sources. Inclusion of a scope element in either alone, or both, obligates the Contractor to provide the indicated work.
 - 1. References in specific Specification sections to other Sections or to the Drawings are made for the Contractor's convenience only, and the omission of a potential reference shall not be interpreted by the Contractor as invalidating the other (unreferenced) provisions.
- E. All work indicated in the documents shall be completed using new equipment and materials, unless explicitly indicated otherwise.
- F. The Architect / Engineer shall not be responsible for design changes or modifications except as set forth by the Architect / Engineer in writing. The Contractor shall comply with the Contract Documents except as directed in writing or as required by an applicable code or product/equipment manufacturer's instructions. The Contractor shall not proceed based on verbal responses by the Architect / Engineer to questions posed by the Contractor.
- G. Do not scale the Drawings. Because of the small scale and diagrammatic nature of the Drawings, it is not possible to indicate offsets, fittings, valves, piping and duct accessories and appurtenances, or similar items which may be required to provide complete operating systems. Carefully investigate conditions affecting the work associated with this project. Check and verify dimensions and existing conditions at the site. Install systems in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features are avoided. Provide items required to meet the project conditions without additional cost to the Owner.
- H. Where the Contractor has been furnished with electronic PDF files of the Drawings or a 3D model that contains layering information (e.g. the PDF has not been 'flattened'), that layering information shall be ignored by the Contractor. Obtaining information from the Drawings for purposes of preparing a bid price (i.e. "take offs") shall be performed by inspection of the as-printed presentation of the Drawings information. Any inconsistencies in the layering information that causes the Contractor using such layering information to prepare a faulty bid shall be considered to be at the Contractor's risk.
- I. The Contractor's use of electronic copies of the Contract Documents shall constitute implicit acknowledgement and acceptance of the following conditions:
 - 1. The electronic data is transferred for a specific, limited purpose; any use of the data for other than its originally intended purpose is prohibited.
 - 2. The Architect / Engineer is the author of the data and retains full rights of authorship in the data and all other rights not specifically conveyed. The electronic data is transferred for the sole benefit of the client for whom the design services have been performed. The recipient may not transmit the information to other parties except for purposes of bidding this project. Use of this material for any other purpose is prohibited without the written permission of the Architect / Engineer.

3. The recipient acknowledges that the data is being transmitted in electronic form for convenience only and that the signed and sealed hard copies are the only true Contract Documents of record.
 4. The recipient is solely responsible for verifying that the information contained in the electronic data file is identical in all material aspects to the Contract Documents of record.
 5. Use of the electronic data is at the sole risk of the recipient, who acknowledges that the electronic data is subject to undetectable alteration or electronic corruption or degradation.
 6. The recipient is solely responsible for confirming that the information is current and for updating the information to reflect any changes in the design subsequent to the date of receipt of the information.
 7. The recipient indemnifies and holds harmless the Architect for all claims and losses resulting from unauthorized or improper use of the data.
 8. Transfer of the information in electronic form does not convey to the recipient a license to use the software that was used to create the information, nor does it create an obligation on the author's part to provide the software to the recipient.
 9. The Architect / Engineer makes no representation or warranty and shall have no liability concerning the operation or performance of the templates or programs, or concerning the accuracy of the data as delivered, or in connection with hardware or any software, any changes made to the electronic materials as delivered, any viruses contained in the materials as delivered, or any other defect or error or alleged defect or error in the materials as delivered.
- J. These documents may not explicitly disclose all final details required for a complete systems installation; however, Contractors shall possess the expertise to include the necessary appointments of complete operating systems in their bid price.
- K. The Contractor shall include in his bid price the cost of all work that is an obvious, logical, or reasonably foreseeable consequence of other work explicitly indicated in the documents.
- L. Damper Quantities: Damper quantities indicated on the Drawings are not explicit. In each location where a life safety damper (e.g. fire, smoke, or combination fire/smoke damper), backdraft damper, or motorized damper is indicated, the Contractor shall provide the quantity of dampers required to meet the indicated performance requirements and completely fill the associated duct, plenum, or opening size. Provide an actuator or operator for each damper, as applicable.
- M. Should a bidding Contractor find conflicts or discrepancies in, or omissions from, the Drawings or Specifications, or should he be in doubt as to their meaning, the bidding Contractor should at once notify the Architect, who will send written instructions to all bidders. If these are ignored by the bidding Contractor, the bidding Contractor will be responsible for furnishing the proper or workable equipment as deemed necessary by the Architect / Engineer. The same shall apply to conflicts or discrepancies between different drawings or between different specification sections.
- N. Details shown on the Drawings shall apply to all instances of such item or condition indicated elsewhere on the Drawings, with or without an explicit reference thereto.
- O. The Drawings and Specifications primarily indicate the work that is required by the contract. In selected instances, an indication of work that is NOT acceptable may be made in the Contract Documents in order to provide additional emphasis or clarity. The omission of a similar statement

elsewhere in the Documents shall not be construed by the Contractor to mean that unspecified or unindicated work will be accepted or is permitted under this contract.

- P. Where a code, standard, or other reference document is referenced, unless explicitly indicated otherwise, it shall be taken to refer to the most recent published version / edition at the time of bidding.
 - 1. Exception: For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- Q. In cases where equipment and materials are specified in the singular or plural number, it is intended that such reference shall apply to as many such items as are required to complete the installation.
- R. In these Specifications, the words "shall," "shall be," "shall include," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
- S. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
- T. Compliance with requirements and performance of the work described in the Contract Documents are the responsibility of the Contractor unless specifically stated otherwise.

1.17 BASIS OF DESIGN PRODUCTS AND SUBSTITUTIONS

- A. Basis of Design: Throughout the project specifications and drawings, materials and equipment may be indicated as the "basis of design" material or equipment. If the bidding Division 23 Contractor desires to furnish equipment of a manufacturer other than that which is indicated to be the "basis of design", even if that alternative manufacturer and/or product name are also listed, it is the full burden of the bidding Division 23 Contractor to verify, prior to submitting a bid price, that the proposed product meets all of the project requirements and specifications. The cost of any additional changes to the work, including changes to the work of other trades / Divisions, that are associated with the Division 23 Contractor's use of a product other than the "basis of design" product, shall be borne by the Division 23 Contractor at no additional cost to the Owner, and the proposed additional changes shall be subject to the approval of the Architect / Engineer.
 - 1. Unless stipulated otherwise in Division 00, Division 01, or the Instructions to Bidders, bidders may elect, during the bidding period, to request the Architect / Engineer's pre-approval, in writing, to substitute such item for the specified item and shall submit supporting data and samples if required, to permit a fair evaluation of the proposed substitution with respect to quality, serviceability and warranty. This request shall be made no less than 10 days prior to the Bid Date.
 - a. The Architect / Engineer is under no obligation to act upon a pre-approval request.
 - 2. Unless stipulated otherwise in Division 01, when submitting for approval a product that was not listed as the basis of design, the Contractor shall explicitly indicate the following in the submittal:

- a. All changes to the work which is required to accommodate the substitution. If no changes are required, then this should be stated instead. The Contractor is responsible for coordinating these changes with the affected trades.
 - b. All deviations from the contract requirements.
 - 1) On an attached separate sheet, prepare a description of all proposed, minor deviations from the contract requirements, along with a Contract Document reference. The Contractor's failure to explicitly identify such deviations shall, at the discretion of the Architect / Engineer, require the Contractor to replace already-installed work with work complying with the contract at no additional cost to the Owner, should the deviation be evidenced to the Owner or Architect / Engineer at a later date.
 3. The Architect / Engineer will evaluate the acceptability of the proposed alternative product in a manner described below in this Article in the paragraph titled "Or-Equal Items". The Architect and Engineer are the sole determiners of acceptability of all products.
- B. Listing of Product and Manufacturer Names: Where names of manufacturers of products are listed in the Specifications, the mere listing of a manufacturer's name, or of a specific product name does not relieve the Contractor of the obligation to meet all provisions of the Contract Documents. All proposed products, even of those of manufacturers listed in the Specifications, are subject to the requirements of the Contract, and therefore are only acceptable provided that they meet the requirements of the Contract, as interpreted by the design professionals (Architect and Engineer).
1. Where a manufacturer or product list is preceded by "subject to compliance with requirements, provide products by one of the following:", or similar language, the Contractor shall interpret this to mean that products or manufacturers not contained within the list are not acceptable and shall not be submitted for approval without conforming to Division 01 substitution requirements.
 2. Where a manufacturer or product list is preceded by "subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:", or similar language, the Contractor shall interpret this to mean that products or manufacturers other than those listed may be submitted for review and possible approval by the Architect / Engineer.
- C. Specification by Product Name: Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, without the listing of additional product or supplier name(s), the Contractor shall interpret the documents to mean that no other product or supplier may be used. However, where the phrase "or-equal" follows the product or supplier name, the name reference is intended to establish the type, function, appearance, and quality required. Other items of material or equipment or material or equipment of other suppliers may be submitted to Architect / Engineer for review under the circumstances described below.
1. "Or-Equal" Items: If, in the Architect / Engineer's sole discretion, an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Engineer as an "or-equal" item. For the purposes of this Paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

- a. In the exercise of reasonable judgment the Architect / Engineer determines that:
 - 1) It is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) It will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
 - 3) It has a proven record of performance and availability of responsive service.
- b. Contractor certifies that, if approved and incorporated into the work:
 - 1) There will be no increase in cost to the Owner or increase in contract times; and
 - 2) It will conform substantially to the detailed requirements of the item named in the Contract Documents.

D. Product Availability:

- 1. Where a product name or model number is indicated on the drawings or specifications and that product model is no longer available, the bid price shall include the currently available product model with the equal or greater quality, capacity, features, and warranty as the unavailable model listed.
- 2. The Contractor is responsible for confirming that all specified products will be available in a timely manner to meet the contract schedule. Should the delivery time schedule of any specified product be an issue that could adversely affect the project schedule, the Contractor shall notify the Architect, in writing, within 14 days following the award of the contract. Documentation as to when specified products were ordered and anticipated delivery dates will be required to be submitted to the Architect at this time.

1.18 SUBMITTALS - GENERAL REQUIREMENTS

- A. Refer to Division 01 for basic requirements.
- B. The Contractor shall provide product data and shop drawings for all equipment, systems, products, and materials proposed for installation under this contract, and as directed in other Division 23 Sections and Division 01.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect / Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet. Submittals lacking this information may be rejected solely on these grounds.
- D. Provide manufacturer's performance curves showing all available performance characteristics with submittals for all fans and pumps utilized on the project.

1.19 WARRANTIES

- A. Defective equipment, materials or workmanship, including damage to the work provided under other Divisions of this contract, shall be replaced or repaired at no additional cost to the Owner for the duration of the stipulated guarantee periods.
- B. Special Warranties: Special manufacturers' warranties that extend beyond the general warranty period are specified in other Division 23 Sections. Special warranties shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
 - 1. Where the duration of a manufacturer's standard warranty exceeds that specified for the special warranty, the manufacturer's warranty shall take precedence.
 - 2. Where the duration of a manufacturer's standard warranty is less than that specified, the manufacturer shall provide a special warranty extension as required, and shall provide a certificate attesting to that extension with the equipment submittal. Failure to include that certificate with the submittal shall be grounds for rejection of the submittal.
 - 3. Special warranties shall defined be interpreted to be non-pro-rated and shall begin on the date of Substantial Completion, unless noted otherwise.
 - a. The manufacturer's warranty time periods may coincide with the Contractor's time period of obligation, but where the manufacturer's warranty contains an expiration date based upon the equipment shipping date, startup date, or some other criteria, the Contractor shall not be relieved of responsibility for covering the full warranty time periods specified.
 - 4. Special warranties and their obligations to the Owner which have been violated by the Contractor's actions (e.g. method of handling, installation, storage, operation, etc.) shall become the responsibility of the Contractor for the original factory warranty duration and coverage. In such cases, the Contractor shall issue written documentation to the Owner attesting to the Contractor's acknowledgement of this responsibility.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Transition Pipe Fittings (Metal to Plastic):
 - a. Charlotte Pipe and Foundry
 - b. Ipex USA LLC
 - c. NIBCO, Inc.; Chemtrol Div.
 - d. Uponor
 - e. Viega LLC

2. Fire- and Smoke-Stopping Materials and Assemblies[HBS1]:

- a. Dow Corning Corp.
- b. 3M Fire Protection Products
- c. GE Silicones
- d. Hilti, Inc.
- e. HoldRite; a Div. of RWC
- f. Specified Technologies Inc. (STI)
- g. Legrand

3. Motor Controllers and Disconnect Switches:

- a. ABB
- b. Allen-Bradley
- c. Eaton
- d. Schneider-Electric
- e. Siemens

4. Rooftop Access Crossovers and Service Platforms:

- a. PHP Systems / Design
- b. Erico 'Caddy Pyramid'; a Div. of nVent
- c. Big Foot Systems; a Div. of Aspen Pumps Group Ltd.
- d. Miro Industries, Inc.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32.
 1. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
 2. Flux: ASTM B 813, non-self-cleaning type.
- C. Brazing Filler Metals: AWS A5.8.
 1. Use Type BCuP (copper-phosphorus) alloy meeting AWS 'BCuP-3' specification (e.g. Sil-Fos 5, or approved equal) for joining copper socket fittings with copper pipe.
 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel, with a compatible flux.

D. Solvent Cements: Manufacturer's standard solvent cements for the following:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: One-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass or copper insert, and one solvent-cement-joint end.
- B. Plastic-to-Metal Transition Unions: MSS SP-107, four-part union. Include brass or copper end, solvent-cement-joint end, rubber gasket, and union nut.

2.5 FIRE AND SMOKE -STOPPING MATERIALS

- A. General Requirements for Fire-and Smoke Stopping Materials: Provide --listed fire-stopping and smoke-stopping systems and assemblies for filling openings around duct, conduit, low-voltage cable, and piping penetrations of Division 23 work through walls, partitions, slabs, and floors as required by the International Building Code and any local amendments.
- B. Fire Stopping Products:
 1. Systems and assemblies shall have fire-resistance ratings equal to or greater than adjacent construction and as established by testing identical assemblies per ASTM E 119 or ASTM E 814.
 2. The listing of the assembly / system proposed at each installation in one of the following shall be considered sufficient evidence of acceptable testing:
 - a. UL 1479 or UL 263 listed in Underwriters Laboratory, Inc. "Fire Resistance Directory".
 - b. Factory Mutual System "Approval Guide"
 - c. Warnock Hersey "Certification Listings"
 - d. A current evaluation report from the National Evaluation Service ("NES") will also be acceptable.
 3. Wall Penetrations: The F-Rating shall be not less than the fire-resistance rating of construction penetrated.
 4. Floor Penetrations:
 - a. F-Rating: Not less than the fire-resistance rating of construction penetrated.
 - b. T-rating: Not less than the F-rating, except for floor penetrations within the cavity of a wall. Supplemental insulation in accordance with tested and listed systems shall be provided on penetrating items where it is required to meet the required T-rating.
 5. It is the Contractor's responsibility to determine the types of penetrations to be sealed and to select appropriate listed fire-stopping assemblies.

6. If a tested assembly is not available for a particular penetration configuration, modify the penetration configuration to suit available assemblies; do not modify assembly configuration except as specifically stated in the test report or as approved by the authority having jurisdiction.
 7. Products installed in air handling plenums shall be UL 2043 listed.
 8. Provide products which:
 - a. Allow normal expansion and contraction movement of the penetrating item without failure of the penetration seal.
 - b. Emit no hazardous, combustible, or irritating by-products during installation or curing period.
 - c. Do not require special tools for installation.
- C. Smoke-stopping: Use any gunnable or pourable joint sealant suitable for the application; use only fully curing types where accessible in the finished work. Provide products which:
1. Allow normal expansion and contraction movement of the penetrating item without failure of the penetration seal.
 2. Emit no hazardous, combustible, or irritating by-products during installation or curing period.
 3. Do not require special tools for installation.
- D. Labels: Red, permanent marking using the words "Fire-Rated Assembly - Do Not Disturb - See Maintenance Instructions" and the testing agency designation, or equivalent as approved by the authority having jurisdiction.
1. For marking fire-stopping and smoke-stopping assemblies, use self-adhesive tape or wired-on labels.
 2. For marking fire and smoke barriers and partitions and slabs themselves, use letters at least 2 inches high.

2.6 MOTOR CONTROLLERS AND DISCONNECT SWITCHES

- A. Throughout this specification, where mechanical equipment is specified to be factory furnished with disconnect switches and/or motor starters, the equipment provided shall be furnished with combination full voltage magnetic starters and fused disconnect switches. All starters and disconnect switches provided under Division 23 shall conform to applicable Division 26 specifications.
- B. Where factory-mounted disconnect switches or motor controllers (magnetic starters or VFDs) are specified in Division 23 Sections, and the equipment manufacturer does not offer such a switch or motor controller as factory equipment, a loose switch or motor controller shall be furnished by the Division 23 Contractor to the Division 26 Contractor for field installation. Switch and motor controller installation and additional wiring costs shall be borne by the Division 23 Contractor.
- C. The short circuit rating of starters, switches, and equipment mounted power distribution and control panels shall be no less than 10,000 AIC, or as elsewhere specified in Division 23 or 26, whichever value is highest.

- D. Starters shall have three (3) current overload relays and low-voltage release. Starters shall be furnished with "Hand-Off-Automatic" switch, red-run light, overload reset, a full set of extra interlocks with provisions for additional sets and a control transformer of ample capacity with 120 volt fused control circuit.
- E. Enclosures shall be NEMA 1 or 12 indoors, and NEMA 3R or 4X where outdoors / exposed to weather.
- F. Where single phase motors are designated to be factory furnished with disconnect switches, the motor shall incorporate a NEMA KS 1, Type HD disconnect switch, with lockable handle.
- G. Disconnect switches shall be horsepower rated to match the horsepower of the motors plus 1.15 service factors.

2.7 MATERIALS USED IN AIR PLENUMS

- A. All materials provided under Division 23 that are installed within, or otherwise exposed to, an air plenum shall meet the requirements of the International Mechanical Code and shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested to UL 723 Test for Surface Burning Characteristics of Building Materials, or ASTM E84. Exceptions include:
 1. Wiring shall have a peak optical density not greater than 0.50, average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet, when tested in accordance with NFPA 262.
 2. Pneumatic tubing shall have a peak optical density not greater than 0.50, average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet, when tested in accordance with UL 1820.
 3. Electrical and control equipment with combustible enclosures, other discrete mechanical products, and firestopping shall be listed and labeled for plenum use in accordance with UL 2043.
 4. Non-metallic ducts and flexible ducts shall be Class 0 or Class 1 air ducts per UL 181.
 5. Pipe and duct insulation shall additionally not flame, glow, smolder, or smoke when tested in accordance with ASTM C4111.
- B. Where a specified material does not comply with the above, and is indicated to be installed in an air plenum, the material shall be concealed with 3M "Fire Barrier Plenum Wrap 5a+", Unifrax "FyreWrap 0.5 Plenum Insulation", or approved equal UL listed insulation that permits the wrapped item(s) to meet the requirements of the International Mechanical code for use in a plenum, per UL 723, UL 1887, NFPA 262, or ASTM E84 test procedures. Such insulation shall also be provided where indicated on the Drawings.
- C. Air plenums may include spaces such as above-ceiling and below-floor cavities, attics, crawlspaces, and mechanical equipment rooms and closets, where those spaces are used to convey supply, return, exhaust, ventilation, or relief airflow.

2.8 CEILING, WALL, AND SHAFT ACCESS PANELS

- A. The Division 23 Contractor shall provide factory-fabricated access panels for access to concealed dampers, valves and other equipment provided under Division 23 where no other means of access is available. Unless more restrictive requirements are referenced in Division 08, comply with the following:
1. Access panels shall be of appropriate size but not less than 20x20 inches, flush type, hinged to drop down and out, screwdriver-operated, stainless steel in tile work and prime coated sheet steel in drywall, plaster or acoustical tile. Exact locations and sizes of panels shall be determined by the Contractor, but panels shall be located for a symmetrical appearance. Locations for access panels in finished areas must be approved by the Architect / Engineer. Access panels are not required at lift-out removable tile ceilings.
 2. At locations where access panels are installed in fire-rated construction, access panels shall contain the 1-1/2-hour fire-rated "B" label; and in addition, shall also be provided with layers of gypsum wall board in a thickness which will supply an additional one and two-hour fire rating equal to the fire rating of adjacent construction.
- B. Acceptable manufacturers / products are specified in Division 08.
- C. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
1. Bar-Co., Inc.
 2. J. L. Industries
 3. Karp Associates, Inc.
 4. Nystrom, Inc.

2.9 AC CONDENSATE DRAIN PIPING

- A. Exterior Installations, including at Rooftop/ Exterior Air Handlers and Air Conditioning Units: **[HDPE piping, as detailed on the Drawings]] [PVC, ASTM D 2665; solid wall, schedule 40, plain ends, with solvent welded socket-type pipe fittings, drainage pattern, conforming to ASTM D 3311][except for those portions detailed on the Drawings to be HDPE].** Terminate piping over a 4-inch thick solid concrete splash block on the roof. Paint the completed trap white or light grey. Apply one coat of primer followed by two top coats of polyurethane paint that is chemically compatible with the piping.
1. Refer to detail on the drawings for the flexible Fernco fitting(s) that shall be incorporated into the trap installation.

2.10 AC CONDENSATE OVERFLOW PROTECTION

- A. Suspended indoor equipment, rooftop equipment, and floor mounted equipment outside of mechanical rooms that generates AC condensate shall be provided with a water level switch complying with UL 508 to provide protection against drain pan overflow by sensing a high

condensate level in the drain pan, in conformance with the **2017** Ohio Mechanical Code. The sensor shall de-energize the compressors upon detection of a high water level.

1. Unless indicated otherwise:
 - a. The switch shall be a Rectorseal Model 'SS3' mounted in the primary drain pan, or approved equal.
 - b. Drains sized at 3/4-inch NPT may also use a Rectorseal Model 'SS1' mounted in the primary drain line, except where equipment is installed in a return air plenum, the sensor shall be approved for use in plenums per UL 2043. The plenum rated switch shall be a Rectorseal Model 'SS2AP' or approved equal installed in the drain pan's auxiliary overflow connection or as otherwise detailed on the Drawings.

2.11 ROOFTOP ACCESS CROSSOVERS AND SERVICE PLATFORMS

- A. Provide access 'crossovers', platforms, roof walkways, stairs, and ladders as indicated on the Drawings to permit safe and building code- and OSHA-compliant maintenance access to all portions of the roof without crossing ductwork by other means (e.g. crawling or climbing), and to elevated equipment.
 1. Crossovers consist of two sets of stairs, a platform.
 2. Platforms for equipment access shall have either one or two sets of stairs, as shown on the Drawings.
 3. Platforms and stairs shall have railings meeting OSHA and building code regulations.
 4. Stair tread and riser dimensions shall meet the applicable provisions of the building code. Ships ladders and vertical ladders are not acceptable substitutes unless explicitly shown on the Drawings.
- B. The crossovers, platforms, stairs, railings, etc. shall be factory designed as complete assemblies to the project requirements and shall meet all Federal and State, OSHA, and Building and Mechanical Code requirements for safe access to equipment requiring maintenance.
- C. The assemblies shall utilize support bases that do not penetrate the roofing system. Provide bracing members, bolts, nuts, washers and other accessories required to provide a complete system. All structural members and fasteners shall be hot dipped galvanized in accordance with ASTM A 153 or A 123.
 1. Where exterior structural steel members are cut, drilled or welded, or galvanizing is damaged, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.
- D. The prefabricated assemblies shall be specifically designed for outdoor use and installation without roof penetrations, flashing or damage to roof materials (insulation, membrane, etc.). Support bases shall be molded high density/high impact polypropylene with UV inhibitors and anti-oxidants.
 1. Prior to installation, verify compatibility with the roof membrane.

2. Provide roof pads. Consult manufacturer of the roofing system as to the type of isolation pads required between the roof and base.
 3. The system shall not void the existing roof bond.
 4. The maximum allowable loadings per support base shall be based on the exact type of roof insulation present, using a safety factor of 2.0 against published minimum ultimate values of insulation compression strength (NRCA Commercial Low-Slope Roofing Materials Guide, 1994 Edition). The manufacturer must also ensure adequacy against punching resistance and overall structural integrity of the roof on which the assembly is placed.
 5. The design shall accommodate a minimum 500 lb. live load.
 6. The clear, usable width of the crossovers, platforms and stairs shall be no less than 36", or as shown on the Drawings, whichever is larger.
- E. When requested by the Architect or Engineer, provide a factory-trained representative of the manufacturer to visit the site while the work is in progress to assure that the installation conforms to the support system manufacturer's design and installation requirements.

PART 3 - EXECUTION

3.1 CONSTRUCTION DURING OCCUPANCY

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire construction period. Cooperate with the Owner during construction to minimize conflicts with the Owner's operations.
- B. Partial Owner Occupancy: Owner will occupy completed areas of building before Substantial Completion. Cooperate with Owner during construction operations to minimize conflicts with Owner's operations.
- C. Partial Owner Occupancy: Owner will occupy areas of the building outside of the immediate work area during the construction period. Cooperate with Owner during construction to minimize conflicts with Owner's operations.
- D. Renovation Phasing: The Project is being constructed in phases, with new / renovated HVAC systems being brought on-line at varying points in time during the project duration. **[The Owner will be retaining full use and occupancy of areas served by HVAC sub-systems not being renovated under the current phase.]**
- E. New Construction Phasing: The Project is being constructed in phases, with new HVAC systems being brought on-line at varying points in time during the project duration. **[The Owner will be occupying areas of the building as they come on-line.]**
- F. The Owner intends to occupy the building during this project. Existing building systems serving the occupied areas shall be maintained and remain functional during the renovation process. The Division 23 Contractor shall be responsible for maintaining the integrity of HVAC air and water distribution systems outside the area of work where such HVAC air and water distribution systems may be compromised by demolition or renovation processes. Therefore, this Contractor shall be responsible to provide on a temporary or permanent basis whatever HVAC equipment, components, piping, ductwork, controls control wiring, accessories, etc., required to maintain the

integrity of HVAC air and water distribution systems outside the renovation area, where such systems may be compromised by demolition, the renovation processes, or connections to existing systems.

- G. Refer to the Article titled "HVAC Demolition" below for additional requirements.

3.2 HVAC DEMOLITION

- A. Refer to Division 01 and Division 02 for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material. Existing work is not permitted to be abandoned in place unless explicitly indicated. Piping shall be tagged as "Abandoned in Place" with the date of abandonment at the points of disconnection as well as along its length at maximum 20-foot intervals, where accessible.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material. Existing work is not permitted to be abandoned in place unless explicitly indicated on the Drawings. Ducts shall be tagged as "Abandoned in Place" with the date of abandonment at the points of disconnection as well as along its length at maximum 20-foot intervals, where accessible.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, ductwork, insulation, wiring, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- D. The disposal of all demolished materials shall be in accordance with all applicable laws, and all costs shall be borne by the Contractor.
- E. Recover refrigerant in demolished systems in accordance with all applicable laws.
- F. Salvage Value: The Owner shall have first rights to all demolished materials and equipment. Existing removed pieces of equipment and materials denoted to be retained by the Owner shall remain the property of the Owner and shall be stored at the site where directed by the Owner and Architect. Equipment shall be stored as complete units with all associated accessories and auxiliary equipment. Equipment shall be disconnected and carefully removed under this contract and shall be transported to the storage areas as directed. Equipment shall be stored in a neat and

workmanlike manner, tagged and identified for future use. All remaining equipment and materials not indicated for salvage shall be done so by Contractor.

- G. Disconnect and remove existing systems and equipment no longer required.
- H. Demolished items shall be cut into sizes small enough to fit through existing building passageways and openings.
- I. Where work is to be performed above existing ceilings, the Contractor will be responsible for removing ceiling tiles, storing tiles and reinstalling tiles after work is complete. The Contractor shall also be responsible for restoring the existing ceilings to their present condition where they are damaged or where the surfaces are dirtied or marred by the work included under this contract. New matching ceiling tiles and supports shall be furnished and installed under this contract where necessary. Existing ceiling tiles shall be kept as clean as possible.
- J. No demolition shall occur which leaves the building interior without weather protection. All demolition of exterior surfaces shall be followed immediately by protective construction, either permanent or temporary.
- K. Review the construction documents, to determine the affected areas of the existing structure. Remove systems in the affected areas not to be reused including equipment, piping, ductwork, controls, hangers, supports, etc.
- L. Schedule demolition work with the Owner.
- M. All existing piping shall be saw-cut, not broken, at point where piping connects to existing.
- N. Where the project requires demolition of existing piping, ductwork, mechanical equipment, and similar services, all such systems shall be terminated in an approved manner to allow affected systems to remain in operation. Provide temporary caps on piping and ductwork at all points of connection between new and existing until new/modified systems are completed in the renovation area. Duct caps shall not be removed until all dust and dirt generating construction activities are complete and the renovation area has been cleaned.
- O. The draining of existing piping systems, and subsequent filling, venting of air, and chemical treatment required to perform the demolition and/or new piping system connections to existing systems shall be provided under this contract.
- P. Repair ductwork and associated insulation and jacketing where control devices and other work installed on or in existing to remain ductwork was removed.
- Q. The Contractor shall, at his own expense, repair, replace and maintain in service, any utilities, facilities or services (underground, over ground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction. The method used by the Contractor in repairing, replacing or maintaining the services shall be approved by the Architect and the Owner.
- R. When demolishing existing equipment, all control wiring or pneumatic tubing serving that equipment shall be properly terminated in an approved manner to allow affected systems to remain in operation. Remove pneumatic tubing back to risers and plug.

- S. Where ductwork systems serve both areas under construction and areas not affected by the construction, all branch ducts in the construction area shall be capped, and fans shall be rebalanced for new air quantities.
- T. Demolition on the Roof: Where existing curb- and roof rail-mounted rooftop equipment, ductwork, or piping is removed / demolished, the associated curb and/or rails shall also be removed, and the roofing system and insulation patched with matching materials.

3.3 CUTTING AND PATCHING

- A. The Division 23 Contractor shall include in his bid all cutting and patching work required for the installation of HVAC work performed under Division 23. Any damage incident to cutting or other causes in the performance of the contract work shall be made good by replacement or repairs in a manner satisfactory to the Architect/ Engineer.
- B. Where piping, ducts, or other equipment pass through fire or smoke rated construction, furnish and install sleeves and thoroughly seal openings around sleeves, pipes, ducts, etc. With fire and smoke resistant materials. Materials shall be provided to maintain the fire rating of the adjacent construction in accordance with the requirements of NFPA and other applicable codes.
- C. No structural members shall be cut without prior approval of the Architect.
- D. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- E. Repair cut surfaces to match adjacent surfaces.

3.4 INSTALLATION OF WORK ON THE ROOF

- A. General Requirements and Scope[HBS2]:
 - 1. Cutting of the roof slab/deck and roofing membrane for Division 23 work shall be by the General Contractor. Perform the work in a manner such as to maintain the roof bond.
 - 2. Roof curbs, roof support rails, and similar flashed-in roof accessories shall be furnished and installed by the Division 23 Contractor for all Division 23 work, except that the General Contractor shall perform cutting of the roof slab/deck and roofing membrane, and shall install base flashing.
 - 3. Where new curbs, roof rails, and other new Division 23 work is installed on the roof that diverts or blocks water drainage to the drainage points (e.g. roof drains, gutters, etc.) , the Division 23 Contractor shall provide crickets on the uphill side of the obstruction in accordance with the roofing system manufacturer's requirements and recommendations. The slope of the cricket surface shall be no less than the slope of the rest of the adjacent roofing.
 - 4. All roofing work shall be performed by experienced roofing sub-contractors who are certified by the roofing system manufacturer to perform installation of the particular existing and new roofing system(s) being installed on this project.
 - 5. Quantity, length, spacing, an arrangement of rooftop equipment, piping, and ductwork support rails shall be as required to provide the required support intervals per referenced

standards in other Division 23 Sections and wind restraint requirements. The quantity shown on the Drawings (if any) is diagrammatic only.

- B. **Sloped Roof Structures:** Roof curbs, pipe chases/portals, roof support rails, and similar items shall be installed so that the top is level and plumb. For installation on a sloped roof structure, either provide a custom built sloped curb or rail built to recognize the slope of the roof at each installed location, or provide hardwood or steel shims. The method and degree of shimming shall comply with the curb, rail, or equipment manufacturer's recommendations, however the shimmed area shall be no less than 50% of the curb or rail bearing surface, and shimming shall not be used to correct for a slope greater than a 1:48 rise / run ratio (2% slope) as measured along the edge or length of the curb or rail. Shims shall be secured to the roof and to the curb or rail. The curb height specified in various Division 23 Sections and on the Drawings is the height of the short side of the curb.
- C. **Minimum Curb Heights:** The Division 23 Contractor shall verify that the height of equipment and duct curbs, support rails, pipe portals/roof chases furnished shall be sufficient to satisfy the requirements of the roofing system manufacturer, accounting for the roof insulation thickness at the location of each installed item, recognizing the use of tapered insulation, where applicable. The required height may be greater than the minimum height specified in other Division 23 Sections.
- D. **Counter Flashing:** The Division 23 Contractor shall provide counter flashing and counter flashing receivers for all flashed in roof accessories (i.e. roof curbs and rails). Counter flashing receivers shall be of watertight construction and shall comply with the requirements of the latest edition of the SMACNA Architectural Sheet Metal Manual.
- E. **Curb Insulation:** The sides of curbs shall be provided with minimum 2" thick fibrous glass duct lining type insulation complying with ASTM C 1071, Type I or II. Insulation shall be provided with the curb or field-applied by the installing Contractor.
- F. **Wind Restraints:** Provide wind restraints for all mechanical work above the roof in accordance with the requirements in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".
- G. **Fastener Sealing:** Fasteners penetrating flashing, equipment housings, and similar construction requiring a weatherproof installation shall be provided with neoprene backed sealing-type washers. Fasteners shall be stainless steel or hot dipped galvanized, except as noted otherwise elsewhere.
- H. **Safety Rails:** For all rooftop equipment that requires regular maintenance (e.g. fans, air conditioners, condensing units, etc.), if such equipment is not located more than 10 feet of away from the edge of the roof or a change in roof elevation exceeding 30" and no existing parapet wall or guard rail meeting OSHA standards is present, the Division 23 Contractor shall provide a non-penetrating, freestanding OSHA-compliant guard rail system along the roof edge, for all portions of the roof edge within 10 feet of any part of the equipment. The guard rail system shall be KeeGuard "Standard", or approved equal. The system shall be provided with a spray applied polyester coating of a custom color as selected by the Architect or Owner.

3.5 FIRESTOPPING AND SMOKESTOPPING INSTALLATION

- A. During bidding, the Division 23 Contractor shall thoroughly review the drawings to determine the location and hour rating of fire resistance rated construction (e.g. walls, shafts, floors, etc.), and shall include in his bid the costs of providing all fire and smoke stopping of Division 23 work required by the 2018 International Building Code and Mechanical Code.
- B. Comply with Division 07 provisions unless more restrictive or demanding requirements are indicated below.
- C. Pre-Installation Inspection: The Division 23 Contractor, with the assistance and technical support of a fire- and smoke-stopping product manufacturer, shall inspect all fire and smoke barriers (floors, walls, partitions, and slabs) for penetrations of Division 23 work, and shall mark or otherwise identify all penetrations indicating action required: 1) repair; 2) firestopping; and/or 3) smokestopping.
 - 1. Conduct inspection prior to covering up or enclosing walls or ceilings.
 - 2. Conduct inspection jointly with authorized representative of authority having jurisdiction.
 - 3. Submit a report detailing findings of inspection to the Architect/ Engineer.
- D. Modifications: If the configuration of a particular penetration does not conform to the configuration necessary for the required firestopping assembly, notify the installer of the penetration for modification of the configuration to suit the assembly; do not use the firestopping assembly in other configurations except as specifically stated in the test report or as approved by the authority having jurisdiction.
- E. Permanent Identification of Penetrations:
 - 1. Near fire and smoke barriers, mark each exposed penetration with label identifying it as a fire-stopped or smoke-stopped assembly.
 - 2. Mark each fire and smoke barrier above lay-in ceilings with words identifying it as a fire or smoke barrier at intervals required by authorities having jurisdiction, but not less than 20 feet.

3.6 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 23 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Due to the small scale of the Drawings, it is not practical to indicate offsets, fittings, valves or similar items, to make a complete operating system. The Drawings are generally diagrammatic and indicative of the work to be installed. The Contractor shall carefully investigate conditions affecting his work and shall install his work in such a manner that interference between pipes, conduit, ducts, equipment, architectural and structural features will be avoided and shall furnish and install such offsets or fittings to meet the conditions at the building, so as to avoid interference without additional cost to the Owner.

- C. Supporting suspended piping and associated components from the underside of the roof and floor decking in steel framed buildings is prohibited. All suspended piping and associated components shall be supported from the building steel structural system.
- D. Install piping at indicated or required slope.
- E. Install components with pressure rating equal to or greater than system operating pressure.
- F. Install piping in concealed locations, except in equipment rooms and service areas, or where explicitly indicated otherwise on the Drawings.
- G. Install piping free of sags and bends.
- H. Install exposed and concealed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- I. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- J. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.
- K. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- M. Elbows: Install factory-fabricated elbows for changes in direction. Long radius elbows shall be used, and changes in elevation shall be performed with two (2) 22.5 deg. elbows in lieu of 45 or 90 degree elbows.
- N. Tee Fittings and Branch Connections: Install branch connections to mains using factory-fabricated tee fittings in main with takeoff out bottom of main, except for up-feed risers with takeoff out top of main line or where space constraints do not permit.
 - 1. "T-drill and similar piping system tee forming techniques are not permitted. Use tee fittings.
- O. Install couplings according to manufacturer's written instructions.
- P. Gravity-fed Condensate Drain Piping: Provide a continuous slope to the indirect waste discharge, no less than 1 percent slope. Piping size shall match the drain pan connection size, 1-1/4", the size indicated on the Drawings, or the minimum size required by the 2015 International Mechanical Code, whichever is largest. Provide a venting tee on piping located downstream side of each condensate drain trap to ensure positive drainage. The top of the tee shall be extended vertically to an elevation above the flood rim of the highest drain pan connected to the drain piping system for those installations provided with a condensate overflow switches. Provide plugged clean outs on each change in direction that exceeds 45 degrees, and at intervals not exceeding 20 feet.
- Q. Condensate Drain Traps: Construct traps of the dimensions required (trap seal depth and net 'fall') for each HVAC unit generating condensate, based on the predicted maximum static pressure in

the cabinet at the location of each trap, including the effect of loaded filters, to ensure the proper drainage of condensate while preventing air passage through the trap (in either direction). After unit startup, flush and prime traps, then test for performance, simulating dirty air filters.

3.7 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.8 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller at final connection to each piece of equipment.

3.9 EQUIPMENT AND PRODUCT INSTALLATION - COMMON REQUIREMENTS

- A. Install manufactured equipment, products, and systems in full accordance with the manufacturer's requirements and recommendations. Note that the manufacturer's requirements and recommendations may be more restrictive or require work beyond that explicitly shown on the Contract Documents. If a manufacturer permits but does not explicitly require their product to be installed in a manner that is inconsistent or incompatible with the Contract Documents, the content of the Contract Documents shall take precedence.
- B. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- C. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- D. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- E. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- F. Install equipment giving right of way to piping installed at required slope.
- G. Supporting equipment from roof and floor decking in steel framed buildings is prohibited. All equipment shall be supported from building steel structural system.

3.10 COORDINATION OF COMMUNICATIONS BETWEEN FACTORY MOUNTED EQUIPMENT CONTROLS AND THE BUILDING AUTOMATION SYSTEM

- A. DDC System Provider / Sub-Contractors Scope and Responsibilities:
 - 1. Provide integration of the factory supplied controls into the Building DDC system. Factory supplied control points shall be programmed into the operator's interface, system applications and graphics software and operate seamlessly with the Building DDC system.
 - 2. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
 - 3. Communication Gateway Connections: Extend the appropriate / required portion of the DDC system network and connect to all packaged equipment controls, air and water flow meters, and other devices provided with communications gateways.
 - a. DDC system graphics shall initially incorporate all 'communication' points available through integration gateways provided with packaged equipment controls, air and water flow meters, and other devices provided with such communications gateways.
 - b. Within the warranty period, remove any points obtained through the gateway from the workstation graphics that the Owner desires to be removed.

B. Division 23 Contractor's Scope and Responsibilities:

1. The Division 23 Contractor shall ensure that the equipment manufacturer's representative is on-site during the DDC system commissioning process to ensure full integration of factory controls with the DDC System.
2. The Division 23 Contractor shall ensure that the manufacturer's representatives have made all project-specific adjustments and settings during equipment start-up to the factory controllers prior to the joint field-commissioning efforts.
3. All equipment furnished with controls that are furnished and installed by the manufacturer shall have BACnet MS/TP or BACnet IP communication capability from the equipment manufacturer.
 - a. Modbus TCP/IP is also acceptable, but only if BACnet MS/TP or BACnet IP is not offered by the equipment manufacturer, and the use of Modbus TCP/IP is fully coordinated between the ATC system supplier and the equipment supplier, and is approved by the Architect / Engineer and the DDC system sub-contractor.
 - b. The Division 23 Contractor's equipment supplier shall provide to the DDC system sub-contractor all documentation required for the mapping in of points obtained through communication gateway into the DDC system.

C. Representatives from each manufacturer providing factory mounted controls and the DDC subcontractor shall cooperate in the integration of the individual systems operation prior to bid and during field installation and commissioning / testing.

3.11 TEMPORARY / CONSTRUCTION-PHASE HVAC SERVICES

- A. Do NOT utilize the permanent HVAC systems, or any portion thereof, to provide construction-phase heating, cooling, ventilation, exhaust, or dehumidification required by the construction process until the permanent systems are permitted to operate continuously, and outside of the start-up process. Temporary systems shall be provided to meet all HVAC needs prior to that time. Temporary / construction-phase HVAC shall be provided by the General Contractor, unless Division 01 indicates otherwise.
1. Changeover from temporary systems to the use of permanent HVAC system shall not occur prior to Substantial Completion.
- B. Refer to Division 23 Section "Ductwork" for requirements related to HVAC system and equipment start-up.

3.12 PAINTING AND FINISHING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09. In the event of a direct conflict between the provisions of Division 09, and this Section, Division 09 shall take precedence.
- B. Do not paint piping specialties and similar items with factory-applied finish. Do not paint bronze or copper materials. Do not paint fastener threads (except on pipe hangers and threaded rods), nameplates, identification devices and labels, flexible connectors, vibration control devices,

meters and gauges, and any items for which the proper function and/or longevity will be compromised by the application of paint.

1. Apply protection / masking to items that shall not receive paint prior to paint surface preparation and painting. Coordinate and schedule this work with the who is performing finish painting. Any damage to Division 23 work due to a failure to mask items that should not have been painted shall be replaced and repaired at no additional cost to the Owner.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish. Marred finishes on items exposed to view in finished spaces shall be replaced with new items when the severity of the damage or quality of the finish repair is judged to be unacceptable by the Architect or Engineer.
- D. At locations where it is necessary to cut and patch existing construction to perform Division 23 work, painting at each location shall be performed by the Division 23 Contractor. New finishes shall match existing finishes. Comply with the provisions of Division 09.

3.13 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Refer to Division 05 for metal fabrications.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Furnish and install miscellaneous iron work including, but not limited to, piping hangers, piping anchors and guides, ductwork hangers and supports, and HVAC equipment supports. Additional structural members shall be furnished and installed to support the HVAC equipment without excessive stress or strain on the building construction. Structural beams and other structural members shall be furnished and installed under this Division for anchors and guides where the building steel is not available or of sufficient size or weight to support or anchor pipe lines and equipment.
- D. Equipment and materials furnished and installed under this Division which are not mounted on bases or floors shall be securely attached and supported from the main supporting structure of the building by metal hangers, clamps and/or brackets. Metal hangers, clamps and/or brackets shall be of suitable design and of sufficient strength to properly and safely support the materials and equipment involved.
- E. Field Welding: Comply with AWS D1.1.
 1. Welding shall be done by qualified welders certified as having fully complied with acceptable qualification tests as prescribed by a reputable testing agency using procedures approved by the American Welding Society.

- F. Structural steel members installed at the exterior of the building or in damp or wet locations shall be hot dipped galvanized after fabrication. Conform to ASTM A123. Where exterior structural steel members are cut, drilled or welded, or galvanizing is damaged, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for electrically commutated motors, and for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on AC power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Related Sections include the following:
 - 1. Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Variable Frequency Drive (VFD) Testing and Adjustment Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.
 - 1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.
- C. Minimum Efficiency: Conform to requirements of NEMA MG 1, Table 12-12, as per the Federal Energy Independence and Security Act of 2007 (EISA), and DOE 10 CFR 431, as applicable, for minimum energy efficiency ratings of motors.
- D. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
 - 1. Measurement of winding resistance.
 - 2. No-load readings of current and speed at rated voltage and frequency.
 - 3. Locked rotor current at rated frequency.
 - 4. High-potential test.
 - 5. Alignment.

1.5 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.
- B. The Division 23 Contractor shall be responsible for any additional costs to the Division 26 Contractor such as larger VFDs and wiring resulting from providing motors with high inrush current ratings such as "super premium" AC induction motors or those with design A starting characteristics.
- C. The Division 23 Contractor shall be responsible for any additional costs to the Division 26 Contractor such as larger VFDs and wiring resulting from any changes in motor sizes initiated by the Division 23 Contractor, from sizes scheduled on the Drawings due to a substitution from the Basis of Design equipment.
- D. Coordinate with the variable frequency drive suppliers to perform drive settings and adjustments appropriate for each drive and control application.

1.6 SPECIAL WARRANTY

- A. Manufacturer's Extended Warranty on Motors Used with Variable-Frequency Controllers: Written warranty, signed by manufacturer agreeing to repair or replace motor, including labor.
 - 1. Warranty Period: Manufacturer's standard, but not less than three (3) years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. 3-Phase Induction Motors:
 - a. Lincoln Motors; Div. of Regal Rexnord
 - b. Marathon Motors; Div. of Regal Rexnord
 - c. General Electric Co.
 - d. Toshiba
 - e. Baldor / Reliance Electric Co.; Div. of ABB Motors and Mechanical Inc.
 - f. US Motors; Div. of Nidec Motor Corp.
 - g. WEG Electric Corp.
 - h. Siemens

- i. TECO-Westinghouse Motor Co.
 - j. Leroy-Somer; Div. of Emerson Industrial Automation
2. Permanent Magnet Electrically Commutated Motors (ECMs):
- a. Baldor; a Div. of ABB Motors and Mechanical Inc.
 - b. EBM-Papst
 - c. Nidec Motor Corp.
 - d. Regal Rexnord
 - e. Zeihl-ABEGG

2.2 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: Determined by voltage of circuit to which motor is connected.
- E. Service Factor: According to NEMA MG 1, unless otherwise indicated.
- F. Enclosures: Open drip-proof (ODP), unless otherwise indicated. Use totally enclosed fan-cooled (TEFC) motors where installed at the exterior of the building or where installed in damp or wet locations.
- G. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- H. Overload Protection:
 - 1. All motors shall be provided with thermal overload protection at the manual or magnetic motor starter or variable frequency controller, as per NFPA 70.
 - 2. All single phase motors, and all three phase motors used with variable frequency controllers shall have integral thermal protective devices.

2.3 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.4 POLYPHASE AC INDUCTION MOTORS

A. Description: NEMA MG 1, medium induction motor.

1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
2. Minimum Energy-Efficient Design: Conform to EISA requirements.
3. Stator: Copper windings, unless otherwise indicated. Multispeed motors shall have separate winding for each speed.
4. Rotor: Random-wound, squirrel cage.
5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
6. Temperature Rise: Match insulation rating, unless otherwise indicated.
7. Insulation: Class F, unless otherwise specified.
8. All squirrel cage, three phase, induction motors 15 HP and larger shall have a maximum locked rotor starting KVA/HP no greater than that specified for NEMA Code "G" (5.6 to 6.3).
9. Enclosure Material: Unless indicated otherwise in other Division 23 Sections, cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
10. Full Load Current Ratings: Shall not exceed NEC Table 430.250 - "Full Load Current, Three-Phase Alternating-Current Motors". If 6 and 8 pole motors with full load currents exceeding the values of this table are provided, the Division 23 Contractor shall be responsible for any additional costs to the Division 26 Contractor such as larger VFDs and input wiring.

B. Motors Used with Variable-Frequency Drives / Controllers (VFDs / VFCs) or Indicated on the Drawings or Elsewhere in the Specifications as "Inverter Duty": Ratings, characteristics, and features coordinated with and approved by controller manufacturer. Comply with the above article "Polyphase Motors" but with the following additional requirements:

1. Design Characteristics: NEMA MG 1, Part 31 "Definite-Purpose Inverter-Fed Polyphase Motors."
2. Temperature Rise: Match rating for Class F insulation.
3. Insulation: Class H.
4. No limitation on cable run between motor and variable-frequency controller.
5. Thermal Protection: Conform to NEMA MG 1 requirements for thermally protected motors.
6. Bearing Protection: Motors 3 HP and larger shall be provided with ring type shaft grounding brushes (EST 'Aegis SGR' or approved equal). The rings may be motor factory mounted or field installed (split-type rings are acceptable). The rings shall be installed on either the drive end or the non-drive end of the motor in accordance with manufacturer's installation instructions. Clean the shaft and coat the contact surface on the shaft with the grounding ring manufacturer's recommended conductive paste (colloidal silver) before installing the ring.
7. Turndown Ratio: No less than 10:1 when powered through a variable frequency drive with scalar (V/Hz) -type control, and no less than 20:1 with a drive with vector-type control.
8. Frequency (Speed) Ratings: The motor shall be factory warranted by motor manufacturer to operate at frequencies between 6Hz and 90 Hz. Higher frequency ratings shall be provided where required by the equipment manufacturer to achieve the required performance, however the speed limitations of Table 30-1 of NEMA MG-1 shall not be exceeded unless explicitly scheduled otherwise.

2.5 SINGLE-PHASE MOTORS

- A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application. Note that none of the motor types listed immediately below may be provided in substitution for a permanent magnet, electrically commutated motor (ECM).
 - 1. Permanent-split capacitor.
 - 2. Split-phase start, capacitor run.
 - 3. Capacitor start, capacitor run.
 - 4. Electrically commutated (see dedicated Article below).
- B. Shaded-Pole Motors: Do not use.
- C. Thermal Protection: Internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range.
- D. Bearings: Ball-bearing type for all EC type motors, belt-connected motors, and other motors with high radial forces on motor shaft. Sealed, permanently prelubricated sleeve bearings are acceptable for other, single-phase motors.

2.6 ELECTRICALLY COMMUTATED MOTORS (ECMs)

- A. Synchronous, constant torque, brushless DC type, specifically designed for HVAC applications, with a permanent magnet rotor and integral solid state inverter circuitry to accept single or 3-phase AC power input and to control the power output and speed of rotation.
 - 1. Integral controllability down to 20% of full, rated speed. No external speed controller shall be required.
 - a. Speed shall be adjustable by integral potentiometer dial (for balancing purposes) and/or by external 0-10 VDC control signal, as required by the application and control sequence of operation. Motors serving fans and pumps indicated in the sequence of operation to have on-off and/or speed control shall receive an external binary and/or analog signal for this purpose. Note that for many EC motors, an analog speed control signal below a certain value is used to automatically de-energize the motor. Coordinate signal type requirements between the equipment supplier and the control system sub-contractor / supplier performing the work of Division 23 Section "Instrumentation and Control for HVAC". For bidding purposes, provide EC motors with both a manual dial and the ability to receive an analog speed signal.
 - 2. Minimum 85% efficiency over full speed range.
 - 3. Permanently lubricated ball bearings which are not dependent on motor speed for lubrication.
 - 4. Integrated power factor correction filter.

5. Integrated motor protection verified by UL to protect the pump against over-/undervoltage, overtemperature of motor and/or electronics, overcurrent, locked rotor, and dry run (no-load condition).
- B. Provide ECMs where explicitly indicated, either in other Division 23 Sections, or on the Drawings.

PART 3 - EXECUTION

3.1 VARIABLE FREQUENCY DRIVE TESTS AND SETTING ADJUSTMENTS

- A. The Division 23 Contractor is responsible for the work of this Article for each variable frequency drive (VFD) provided under this Project controlling Division 23 equipment regardless of which Division provided each VFD.
- B. Adjustments shall be made in accordance with the VFD manufacturer's recommendations and requirements. Where required, the VFD manufacturer's authorized representative shall be present for drive commissioning and set-up procedures/adjustments. For factory equipment mounted VFDs, the equipment manufacturer's representative shall be present. The Division 23 Contractor shall include in his bid the costs of obtaining the services of these representatives. The Division 23 Contractor shall assume that dedicated trips to the project site will be necessary to perform all necessary adjustments. No additional payment will be made by the Owner for these services.
- C. All required VFD parameter setting adjustments shall be made to ensure the proper and safe operation of the driven equipment, including start up, shut-down, and emergency operational modes, including VFD bypass / hand modes, as applicable. The required tests and adjustments include, but are not limited to, the following:
1. Coordinate with the automatic temperature controls supplier / sub-contractor to make all necessary operational and control parameter adjustments, including lock-out of any resonant speeds.
 2. VFD Communications: Verify that the VFD is communicating with the building automation system, including read and write parameter settings.
 3. Testing and Balancing: Perform the following adjustments in cooperation with the Testing and Balancing Agent.
 - a. For belt-drive fans equipped with variable frequency drives, set the drive output to 60 Hz and adjust the belt-drive sheaves to achieve the scheduled (design) fan performance.
 - 1) Determine and record the maximum output frequency that results in operation of the motor at 95% of the motor nameplate ampacity.
 - 2) Report the recorded test results to the Engineer.
 - 3) Re-set the VFDs maximum output speed to the value recommended by the Architect / Engineer.
 - 4) Verify that the final settings corresponds to, or is lower than, the maximum RPM for the fan wheel class, and will prevent motor overload in normal operation.

- b. For direct-drive fans equipped with variable frequency drives, determine the output frequency of the drive required to achieve the scheduled (design) fan performance.
 - 1) Note that the required output frequency is very often above 60 Hz.
 - 2) Record the required output frequency at the design fan performance and measure voltage and amps of the motor for each phase.
 - 3) Additionally, determine and record the maximum output frequency that results in operation of the motor at 95% of the motor nameplate ampacity or operation of the fan just above breakdown torque of the motor, whichever is reached first.
 - 4) Report the recorded test results to the Engineer.
 - 5) Re-set the VFDs maximum output speed to the value recommended by the Architect / Engineer.
 - 6) Verify that the final settings corresponds to, or is lower than, the maximum RPM for the fan wheel class, and will prevent motor overload in normal operation.
 - c. For pumps powered through variable frequency drives, set the maximum output frequency of the drive to a speed that results in operation of the motor at 95% of the motor nameplate ampacity. Note that this will often be above 60 Hz.
4. Test for smooth and stable operation of the equipment at speeds varying from minimum to maximum.
 5. Test the VFD manual bypass (when present) and 'soft' bypass / hand mode to prove proper operation.
 - a. For direct drive fans, set the maximum output frequency of the drive (including under soft bypass / hand modes) to prevent operating the fan wheel from operating at an RPM that is above the maximum RPM for the fan wheel class, or at an ampacity that overloads the motor.
 6. VFD carrier frequency settings shall be field adjusted to the lowest value that does not create objectionable noise in occupied spaces in order to minimize motor temperatures. Settings lower than 6 kHz are desirable.
 7. In cooperation with the Division 26 Contractor, set field-adjustable switches and circuit-breaker trip ranges.
 8. Jog each motor and verify proper motor rotation.
 9. For individual VFDs serving more than one motor load, verify that the VFD is operating in a compatible mode as recommended by the VFD manufacturer (e.g. 'voltage-frequency' mode).
 10. Conduct tests to verify that the following VFD features are working correctly:
 - a. Automatic Reset/Restart: The VFD attempts six (6) restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction.
 - b. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
 - c. Flying Start: Enable and test the bidirectional auto-speed search feature that permits starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

- d. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- 11. Verify that selector switches with control circuit in both hand and automatic positions have been connected to all safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.
- 12. Verify that 'run permit' interlock wiring between early break, late make auxiliary contacts on the load-side disconnect switch and remote VFD has been provided. If such interlock wiring is not indicated on the electrical documents, then provide signage at the local disconnect switches and the associated VFD(s) that reads "De-energize equipment at the VFD prior to interrupting power to the equipment at the disconnect switch."

END OF SECTION 230513

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Division 23 Sections include the following:
 - 1. "Common Work Results for HVAC" for metal fabrications for pipe and equipment supports.
 - 2. Division 23 Section "Vibration Controls for HVAC" for equipment and piping systems requiring vibration isolation hangers and supports.
 - 3. "Ductwork" for duct hangers and supports.
 - 4. Various other Division 23 Sections where exterior equipment is specified to be factory designed and constructed with an integral wind resistance rating.

1.2 SUMMARY

- A. This Section includes hangers and supports for HVAC system piping and equipment.
- B. This Section also includes delegated design requirements for wind restraints for exterior ductwork, and piping.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in ANSI / MSS SP-58.

1.4 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents, and test water.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

B. Delegated Design Calculations and Shop Drawings: The Division 23 Contractor shall provide fabrication and installation drawings and include load and stress analyses calculations, signed and sealed by a professional engineer registered in Ohio for the following:

1. Channel and trapeze type supports.
2. Equipment supports.
3. Pipeline anchors and guides.
4. Wind-Restraint Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the building structural system. Show attachment locations, methods, materials, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during design wind events. For equipment, provide dimensioned outline drawings of the unit, identify the center of gravity, and locate and describe mounting and anchoring provisions. Indicate association and coordination with vibration isolation devices. Comply with requirements in other Sections for equipment mounted outdoors.

a. Design Analysis: To support selection and arrangement of wind restraints for exterior equipment and ductwork . Include calculations of combined tensile and shear loads. Calculate static and dynamic loading due to equipment weight, operation, and wind forces required to select wind restraints.

1) Wind-Restraint Loading: Comply with ASCE Standard 7 (2010) , as per the project location, Exposure Category **B**, and a Building Risk Category of III. Design restraints for the greater of the following:

- a) 3-Second Gust Design Wind Speed per ASCE Std. 7.
- b) 16 lb./sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

- 2) Importance Factor: 1.0.
- 3) Dead weight gravity forces (except for water contained within piping) may be considered as resistance to wind forces, but friction forces shall not.
- 4) Apply safety factors no less than 3.0.
- 5) Restraints shall resist wind forces without damage to the restraints or the associated duct, pipe, or equipment.
- 6) All connections are subject to the approval of the Structural Engineer of Record. The Contractor shall submit loads at each connection to the Structural Engineer of Record for approval.

1.6 INFORMATIONAL SUBMITTALS

A. Welding Certificates: Copies of certificates for welding procedures and operators.

1.7 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

- B. Delegated Design and Engineering Responsibility: The Division 23 Contractor is responsible for the delegated design and engineering provisions of this Section. Provide for the design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze, and equipment support, by a qualified professional engineer.
1. Delegated Design Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in Ohio and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.
 2. The engineer providing these design services shall be the same individual providing calculations and design in accordance with the delegated design requirements of Division 23 Section "Vibration Controls for HVAC". Refer to the Quality Assurance article in this Section for additional qualification requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Channel Support Systems:
 - a. Anvil International, Inc.; Power-Strut Unit.
 - b. Carpenter & Paterson, Inc.
 - c. National Pipe Hanger Corp.
 - d. Thomas & Betts Corp.
 - e. Unistrut Corp.
 - f. ERICO International Corporation.
 - g. Walraven
 2. Prefabricated Flashed-In Roof Support Rails:
 - a. Roof Products and Systems (RPS); a Div. of Hart and Cooley Inc.
 - b. Thycurb Inc.
 - c. The Pate Co.
 - d. Greenheck Fan Corp.
 - e. MKT Metal Manufacturing
 - f. MicroMetl Corp.
 - g. PortalsPlus; a Div. of Hart and Cooley Inc.
 - h. United Enertech Corp.

2.2 MANUFACTURED UNITS

- A. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
 - 1. Coatings: Manufacturer's standard finish. All channel support systems and accessories exposed to weather shall be stainless steel or hot-dipped galvanized, no exceptions.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.3 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, galvanized. All structural steel members, plates, shapes, and bars exposed to weather shall be hot-dipped galvanized, no exceptions.
- B. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, noncorrosive, and nongaseous.
 - 3. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

2.4 PREFABRICATED FLASHED-IN ROOF SUPPORT RAILS

- A. General: Provide prefabricated equipment mounting rails for installation of roof mounted equipment. Rails shall be secured to the roof structure. Hardwood blocking shall be provided where required to render a level and smooth surface under the full length of bearing surface of the rail. Rails shall be constructed to recognize the roof slope and render the top of the rail flat and plumb in each direction.
- B. Construction: Equipment rails shall be minimum 14 gauge galvanized steel of monolithic construction with integral base plate/mounting flange, continuously-welded corner seams, factory-installed pressure-treated wood nailers, 1-1/2" thick 3 PCF density fiberglass insulation adhered to inside of curb walls, and 24 gauge galvanized steel counter-flashing. Lengths and quantity shall be as required for installation of the equipment shown.
 - 1. Overall height of equipment rails shall be no less than 24". Provide taller rails or additional support steel from the rails in order to elevate the equipment above the roof as required, or as scheduled in Figure 6-4 of SMACNA Publication "HVAC Duct Construction Standards-Metal and Flexible, 3rd Edition (2005), whichever is higher.
 - 2. Fasteners and other hardware used to fasten equipment to the wood nailers shall be stainless steel or hot dipped galvanized steel, with neoprene backed washers.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Refer to Division 23 Section "Vibration Controls for HVAC" for equipment and piping systems requiring vibration isolation hangers and supports. Vibration isolated piping and equipment shall be installed such that they do not contact building structure, walls, or other building elements or work that fixed in place.

3.2 HANGER AND SUPPORT INSTALLATION - GENERAL REQUIREMENTS

- A. Hanging piping and equipment from roof and floor decking in steel framed buildings is prohibited. All equipment shall be hung from building steel structural system (e.g. steel beams and joists).
 - 1. Piping and equipment shall be supported directly from the building's steel beams or from miscellaneous structural steel provided by the Division 23 Contractor bearing on steel beams.
 - 2. Joist Connections: Loads supported by steel bar joists exceeding 100 lbs. shall be located at the joist panel points, and shall not impose an eccentric load (twisting moment). Provide supplemental steel and align direct hanger connections to the joists with the joist centerline. Connect to both of the upper chord angles of the joist wherever it is possible to do so. Whenever it is not possible for loads exceeding 100 lbs. to be located a joist panel point, provide a strut to transfer the load to a panel point on the opposite chord. All joist reinforcement / modifications shall meet with the approval of the joist manufacturer and shall follow the recommendation of the Steel Joist Institute.
 - 3. Do not drill or cut building structural steel.
 - 4. Do not weld to building structural steel without explicit pre-approval from the Architect/Engineer. Repair fireproofing after welding.
- B. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements related to installation of work on the roof.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Roof-Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof support rail.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead.
- B. Fabricate structural steel stands to support equipment above floor where required or indicated on the Drawings. Where an equipment stand is not indicated or required, set equipment on concrete housekeeping pads no less than 4" high.
- C. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- D. Provide lateral bracing, to prevent swaying, for equipment supports.
- E. Rooftop equipment that is not installed on a perimeter roof curb shall be supported on flashed-in prefabricated roof support rails, unless indicated otherwise.
 - 1. Rails shall span a minimum of two (2) joists and not cantilever more than 12", and shall be anchored to the roof structural system (not the roof deck). Minimum rail quantity and maximum spacing shall be as specified elsewhere or to meet the wind restraint requirements, as determined through delegated design.

3.4 ROOF CURB, PIPE CHASE / PORTAL, AND ROOF SUPPORT RAIL INSTALLATION

- A. Install roof curbs, pipe chases/ portals, and support rails in such manner as maintain roof bond. Provide roof opening, flashing, counter-flashing, sealant, roof insulation and structural framing members. Secure roof-mounted equipment to support rails with stainless steel hardware.
- B. Rooftop piping shall be supported on flashed-in prefabricated roof support rails, unless indicated otherwise.

1. Rails shall span a minimum of two (2) joists and not cantilever more than 12", and shall be anchored to the roof structural system (not the roof deck). Minimum rail quantity and maximum spacing shall be as specified elsewhere or to meet the wind restraint requirements, as determined through delegated design.
- C. Piping penetrations of the roof shall be made with insulated metal roof curbs.
- D. Rooftop equipment shall be installed on flashed-in roof curbs or rails unless indicated otherwise.

3.5 WIND RESTRAINTS

- A. Support and brace all exterior piping, ductwork, gas vents, and equipment against the specified wind and dead loads. Final requirements for supplemental wind bracing systems and materials shall be as determined by the herein-specified delegated design engineer.
- B. Restraints and braces shall connect to the building structural system, such as flanges of structural beams, upper truss cords of bar joists at panel points, cast in place inserts, or wedge-type concrete anchors.
- C. All connections are subject to the approval of the Structural Engineer of Record. The Contractor shall submit loads at each connection to the Structural Engineer of Record for approval.
- D. Do not utilize corrugated metal roof decking for connection of wind restraints.
- E. Installation of restraints shall not cause any change in position of the restrained item resulting in stresses or misalignment.
- F. Do not brace a system to two independent structures such as a roof and a wall.
- G. Friction clips shall not be used for anchorage attachments.
- H. Equipment Restraints:
 1. Comply with Section 301.15 the 2015 International Mechanical Code.
 2. Provide wind restraints to transmit wind loads from the equipment to the equipment curb (where applicable), and from the equipment base, equipment curb, and/or equipment anchorage points to the building structural system.
 3. All restraint systems shall be installed in strict accordance with the equipment manufacturer's restraint guidelines and all certified data.
 4. Equipment mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction and vertical restraints shall be provided to resist overturning. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system indicated. Do not install any equipment or duct that makes rigid connections with the building unless isolation is not indicated.
 5. Refer to various other Division 23 Sections where exterior equipment is specified to be factory designed and constructed with a wind resistance rating so that the equipment itself will not suffer damage when subjected to design wind forces.

- a. Where such requirements are met, supplemental external reinforcement and/or restraints applied to the equipment itself to provide equipment wind resistance detailed on the Drawings (if any) may be omitted.
- b. Where such requirements are not met, supplemental reinforcement may be field-provided / field-applied to the equipment by the installing Contractor as alternative method of compliance with the specification, however such reinforcement shall meet with the approval of the Architect / Engineer, the delegated design engineer, and the equipment manufacturer.

I. Ductwork Supports and Restraints:

1. Provide supports for exterior ductwork to support the weight of the ductwork in accordance with Division 23 Section "Ductwork".
2. Provide wind restraints to transmit wind loads from the ductwork to the duct supports and/or roof rail, and from the support / roof rail to the building structural system.
3. Wind restraints for all directions (transverse, longitudinal, and uplift) shall be provided at each duct support. Branch ducts shall not be used to restrain main ducts. Transverse restraint for one duct section shall not also act as a longitudinal restraint for a duct section connected perpendicular to it
4. Construction of exterior ductwork, including material gauges and internal and external reinforcements, shall be sufficient to prevent damage, distortion, and movement of the ductwork between wind restraint locations.

J. Gas Vent Restraints:

1. Provide wind restraints to transmit wind loads from the gas vents to the building structural system.
2. Wind restraints for all directions (transverse, longitudinal, and uplift) shall be provided at each gas vent support.
3. Restraints may take the form of guy wires and rigid elements.
4. Secure restraints to the gas vent system in accordance with the recommendations of the gas vent manufacturer.
5. Forces at moment connections to gas vents shall not exceed the gas vent manufacturer's recommended limits.

K. Piping Restraints:

1. Provide wind restraints to transmit wind loads from the piping to the piping supports and/or roof rail, and from the support / roof rail to the building structural system.
2. Comply with MSS SP-127.
3. Transverse piping restraints shall be at 40-foot maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
4. Longitudinal restraints shall be at 80-foot maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
5. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24-inches of the elbow or tee, or if the combined stresses are within allowable limits at longer distances.
6. Hold down clamps shall be used to attach pipe to all trapeze members or support rails before applying wind restraints.

7. Branch lines shall not be used to restrain main lines.

3.6 METAL FABRICATIONS

- A. Furnish and install miscellaneous iron work including, but not limited to, piping hangers, piping anchors and guides, and HVAC equipment supports. Additional structural members shall be furnished and installed to support the HVAC equipment without excessive stress or strain on the building construction. Structural beams and other structural members shall be furnished and installed under this Contract for anchors and guides where the building steel is not available or of sufficient size or weight to support or anchor pipe lines and equipment.
- B. Equipment and materials furnished and installed under this Contract which are not mounted on bases or floors shall be securely attached and supported from the main supporting structure of the building by metal hangers, clamps and/or brackets. Metal hangers, clamps and/or brackets shall be of suitable design and of sufficient strength to properly and safely support the materials and equipment involved.
- C. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
 1. Where exterior structural steel members are cut, drilled or welded, or galvanizing is damaged, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.
- D. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- E. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Welding shall be done by qualified welders certified as having fully complied with acceptable qualification tests as prescribed by a reputable testing agency using procedures approved by the American Welding Society.
 2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 3. Obtain fusion without undercut or overlap.
 4. Remove welding flux immediately.
 5. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.7 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated or required slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches once the coordinated installations are complete. Any rod ends within 6'-8" of the finished floor shall be provided with rubber or vinyl screw thread caps and the piping or hanger marked with low clearance warning labels.

3.8 PAINTING

- A. Touching Up: 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 a 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 A 780.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Division 23 Sections include the following:
 - 1. "Hangers and Supports for HVAC Piping and Equipment" for pipe hanger restraints.
 - 2. "Ductwork" for hanger materials for ductwork.
 - 3. "Air Duct Accessories" for flexible duct connectors.
 - 4. "Common Work Results for HVAC" for flexible pipe connectors.
 - 5. Various Division 23 equipment specification sections for equipment requiring factory-furnished internal vibration isolation.

1.2 SUMMARY

- A. This Section includes vibration isolators, thrust restraints, vibration isolation roof curbs, and vibration isolation bases.

1.3 ACTION SUBMITTALS

- A. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load - deflection curves.
- B. Shop Drawings and Delegated Design: The Division 23 Contractor shall provide designs and calculations, certified by a professional engineer, for the following:
 - 1. Vibration Isolation Design Calculations: Calculations for selection of vibration isolators and design of vibration isolation bases, hangers, and supports. Exception: Rotating equipment vibration isolation products not subject to wind loads that are provided as part of factory-engineered equipment packages.
 - 2. Wind Restraint Design Calculations: Vibration isolation products applied to exterior work shall be designed and selected to resist without damage the IBC design winds.
 - a. Wind-Restraint Loading: Comply with ASCE Standard 7 (2010), as per the project location, Exposure Category B, and a Building Risk Category of III. Design restraints for the greater of the following:
 - 1) 3-Second Gust Design Wind Speed per ASCE Std. 7.
 - 2) 16 lb./sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

- b. Importance Factor: 1.0.
 - c. Dead weight gravity forces (except for water contained within piping and ductwork) may be considered as resistance to wind forces, but friction forces shall not.
 - d. Apply safety factors no less than 3.0.
 - e. Restraints shall resist wind forces without damage to the restraints or the associated duct, pipe, or equipment.
 - f. All connections are subject to the approval of the Structural Engineer of Record. The Contractor shall submit loads at each connection to the Structural Engineer of Record for approval
- C. Vibration Isolation Spring Rail Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include spring rail weights.
- D. Vibration Isolation Roof Curb Details: Detail fabrication, including anchorages and attachments to the roof curb and to the supported equipment. Include weights.
- E. Spring Isolation and Sound Attenuating Roof Curbs Product Data and Shop Drawing Submittals:
- 1. Product Data: Indicate curb, silencer, and attenuating barrier materials of construction. Indicate types, styles, materials, and finishes for each type of isolator specified. Include load - deflection curves.
 - a. Submittals shall include a written test report by a third party organization showing airside silencing elements have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
 - 2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

1.5 QUALITY ASSURANCE

- A. NRCA Compliance: Roof curbs shall be constructed according to recommendations of NRCA.

1.6 COORDINATION

- A. Coordinate layout and installation of vibration isolation devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

- B. Coordinate installation of equipment supports.
- C. Coordinate installation of roof curbs and roof penetrations. Verify the exact roof curb and rail dimensional requirements with the equipment manufacturer.

PART 2 - PRODUCTS

2.1 SPRING ISOLATION ROOF CURB

- A. Manufacturers: Subject to compliance with requirements, the Contractor may provide products by the following:
 - 1. Thybar Corp. ("Vibro-Curb III")
- B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight roof curb designed to resiliently support equipment and to withstand wind forces. The curb shall be custom constructed to receive field ductwork in the exact locations and sizes, and meet the support and dimensional requirements of the supported equipment.
- C. Wind Resistance: Curbs shall be laterally stable with internal bracing, and shall be constructed to resist the wind forces exerted on the curb by the supported equipment in an IBC-specified design wind as per the project conditions described in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment". Curbs shall be provided with a bottom flange suitable for securing the curb to the roof deck / building structural system in order to resist the design wind loads.
- D. Curb: The curb shall be constructed from a minimum of 16 gauge G90 galvanized perimeter steel with a factory attached wood nailer. The curb shall completely encompass the entire perimeter of the rooftop unit. The bottom portion of the curb receiving the roof base flashing shall be a minimum of 16" tall. The perimeter steel seams shall be continuously welded. The galvanized perimeter curb steel shall be attached to a structural steel frame that incorporates a minimum of four (4) restrained spring isolators that support the rooftop unit. The curb shall have factory installed lifting points. Curb sides and ends shall be lined with 2" thick fiberglass board insulation, factory installed. The curb section shall be complete with factory installed duct supports and supply air and return air neoprene flex connections. Curb access doors or sections shall be installed as required for servicing curb components or accessories. The curb shall be constructed to match the pitch of the roof and the perimeter of the curb shall have a flexible neoprene air and weather seal joining the upper and lower curb sections. Continuous closed cell sponge material shall be provided between the top of the spring isolation curb and underside of the rooftop unit to provide a waterproof seal.
 - 1. Overhung condensing unit sections shall be supported by a structural steel pedestal assembly with isolation springs that are vertically and laterally restrained and shall be installed as the main curb section. A galvanized and insulated pan shall be provided under condensing sections that are located within the curb perimeter.

- E. Spring Isolation: The isolation springs shall be of the vertical and laterally restrained type. The springs shall be selected to provide 50% additional travel to solid. Isolation springs shall be powder coated for corrosion resistance and have a minimum static spring deflection of 3", or as scheduled on the Drawings, whichever is greater. The springs shall have a lateral stiffness of no less than 1.2x the vertical stiffness. The isolators shall allow 1/4" of lateral movement before resisting wind loads in any lateral direction. Snubbers shall be neoprene lined (i.e. no metal-to-metal contact).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS AND INSTALLATION

- A. General: Except as otherwise indicated*, select vibration control products in accordance with ASHRAE Handbook, 2015 Edition of HVAC Applications Volume, Chapter 48 "Noise and Vibration Control", including Table 47. Where more than one type of product is recommended in Table 47, the selection is the Contractor's option so long as that type of product is specified in this Section.
 - 1. Exceptions:
 - a. *Specific indications on the Drawings or in an equipment specification Section elsewhere in Division 23 shall take precedence over the above referenced chapter of the ASHRAE HVAC Applications Handbook.
 - B. All rotating, vibrating, and motor driven equipment shall be provided with field applied vibration isolation from one of the manufacturers listed elsewhere in this Section, except the following:
 - 1. Where internal isolation has been provided as part of the factory-manufactured equipment package, except for equipment where spring isolation roof curbs or spring rails have been specified. The isolator products used shall comply with this Section, and other specific indications in the Contract Documents, including type and minimum amount of static deflection.
 - C. Vertical Restraints: Vibration isolators shall be of the restrained type incorporating a vertical limit stop when applied to exterior equipment.

- D. Restrained Isolation Roof Curbs: Provide for rooftop equipment as indicated on the Drawings.
1. Internal isolators that are factory-provided with rooftop equipment, other than rubber-in-shear or rubber pad isolators with less than 1/3" static deflection, shall either be omitted or "locked out" to prevent the possibility of resonance with the curb springs.
 2. Install the curb on the roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Coordinate roof penetrations and flashing with roof construction. Secure units to upper curb rail, and secure curb base to roof framing with anchor bolts and supplemental steel members. The installation shall provide the wind resistance required by the International Building Code and Division 23 Section "Hangers and Supports for HVAC".
 - a. Install roof curbs in such manner as maintain roof bond.
 - b. Provide roof opening, flashing, counter-flashing, sealant, roof insulation and structural framing members.
 - c. Secure units to roof curbs with stainless steel hardware with gasketed sealing washers.
 - d. Provide soft neoprene gasketing between the unit base and the top of the curb.
- E. Install and anchor vibration-control products according to manufacturer's written instructions and authorities having jurisdiction.
- F. Anchor exterior mounts, isolators, and hangers to vibration isolation bases. Bolt isolator baseplates to roof supports or structural supports as required by authorities having jurisdiction and the wind restrain design.
- G. Installation of vibration isolators shall not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- H. Equipment isolators and bases shall be dedicated to a single piece of vibrating equipment.
- I. No rigid connections or contact between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified. Coordinate work with other trades to avoid rigid contact with the building elements or the work of other trades.
- J. Locate isolation hangers as near to the overhead support structure as possible.
- K. Provide flexible duct connectors on duct connections to fan-containing equipment as specified in Division 23 Section "Air Duct Accessories".
- L. Comply with requirements in Division 07 for installation of roof curbs and rails and roof penetrations.
- M. Ductwork: Combination rubber and spring vibration isolation shall be provided for piping and ductwork as follows:
1. Ductwork: All ducts connected to fans and fan-containing equipment with an operating total static pressure over 4" w.g. Isolation shall be provided for the first 25 feet from the equipment, down all duct paths. Isolators shall have no less than 3/4" static deflection.

3.3 ADJUSTING

- A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.
- B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop. Perform adjustments with the fans operating at the maximum anticipated system operating pressures.

END OF SECTION 230548

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
- C. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.
- D. Refer to the control sequences of operation and Division 23 Section "Instrumentation and Control for HVAC" for additional work required by the TAB Agent to assist the DDC system provider / sub-contractor in the calibrating or verifying airflow measuring stations and determining required duct supply pressure setpoints, variable speed drive settings, building pressurization airflow allowances, and similar control system values requiring field measurements of airflow, water flow, or pressure.

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems, including the following:
 - 1. Pre-Demolition Testing.
 - 2. Air Systems:
 - a. Constant-volume air systems.
 - b. Multi-zone variable-air-volume systems.
 - 3. Testing, Adjusting, and Balancing of Equipment, including, but not limited to:
 - a. Heat exchangers.
 - b. Motors.
 - c. Fans, and fan-containing equipment.
 - 4. Verifying accuracy and performing field calibration of airflow measuring stations.
 - 5. HVAC equipment quantitative-performance settings.
 - 6. Existing systems TAB.
 - 7. Diffuser and grille supply pattern adjusting.
 - 8. Verifying that automatic control devices are functioning properly.
 - 9. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Airflow Control Terminal: Device installed in the duct system that automatically regulates the airflow rate passing through the device. (e.g. VAV boxes, air valves, etc.)
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- D. Deficiency: Any installation, measurement, or finding outside the tolerances allowed by the referenced testing and balancing procedural standards or project specifications.
- E. Diversity: In air or hydronic systems, diversity is the term used to describe the difference in air or water volume between the prime mover (fan or pump) and sum of the terminal elements.
- F. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- G. Memory Stop: An adjustable mechanical device that allows a valve to be closed (for service) and limits the valve to a predetermined position when re-opened.
- H. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- I. Report Forms: Test data sheets for recording test data in logical order.
- J. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- K. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- L. TAB (Testing, Adjusting, and Balancing): A systematic process or service applied to HVAC systems, and other environmental systems, to achieve and document air and hydronic flow rates.
- M. TAB Agent: The contractor performing the work of this Section.
- N. Terminals: In the context of a hydronic system, a device such as a coil where heat is either removed or added to the working fluid, other than the system prime movers (chillers, cooling towers, boilers, etc.).
- O. Terminal Outlet or Inlet: A point where air, enters or leaves the ductwork distribution system. (e.g. diffuser, register, grille, etc.)
- P. Test: A procedure to determine quantitative performance of a system or equipment.

- Q. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- R. AABC: Associated Air Balance Council.
- S. AMCA: Air Movement and Control Association.
- T. NEBB: National Environmental Balancing Bureau.
- U. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 ACTION SUBMITTALS

- A. Testing and Balancing Agent Qualifications: Verification of experience and capability of the testing and balancing agent. The purpose of this submittal is to establish, in a proactive manner, that the agent proposed by the Division 23 Contractor to perform the work of this Section is qualified. The Contractor's failure to obtain approval for this submittal prevents the Contractor from utilizing the proposed service provider. Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below. Also submit the following:
 - 1. Resumes of the technicians anticipated to work on this project.
 - a. Note: Do not submit 'generic' firm resumes or resumes of firm principals unless those individuals are proposed to do the actual testing and balancing work on site for this project.
 - 2. A list of projects completed for each technician within the last 12 months. Include no less than three (3) client references with contact information relevant to projects completed within the last 12 months for each technician. The same project may be used more than once if multiple technicians worked on the project.
 - 3. A list of any projects completed for this same Owner within the last 3 years, if any, along with the technicians who worked on those projects, and the Owner's contact information.

1.5 INFORMATIONAL SUBMITTALS

- A. Pre-Demolition Measurements and Tests Report.
- B. Certified Testing, Adjusting, and Balancing Reports: Submit reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- C. Sample Report Forms: Submit sample testing, adjusting, and balancing report forms.

1.6 CLOSEOUT SUBMITTALS

- A. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.7 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent that is currently certified by either AABC or NEBB.
 - 1. The company / agency as a whole shall be certified, and at least one individually certified supervisor or technician shall be supervising or participating in the work at the project site at all times when testing and balancing activities are taking place.
 - 2. The individually certified supervisor or technician shall be a AABC "TBE" or NEBB Certified with a minimum of eight (8) years' experience in performing HVAC system testing, adjusting and balancing, with at least four (4) of those years in a supervisory position.
 - 3. At least one of the on-site certified supervisors or technicians shall have performed work characteristic of this project on at least three (3) other similar projects within the last five (5) years.
- B. Sub-Contracting Arrangement: The Agent shall be an independent company that is not financially affiliated with the Division 23 Contractor.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" or from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards or in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification"Project.
- F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.8 PROJECT CONDITIONS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.
- B. Partial Owner Occupancy: Owner will occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

- C. Partial Owner Occupancy: Owner will occupy areas of building outside of the immediate work area during the testing, adjusting, and balancing period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- D. Renovation Phasing: The Project is being constructed in phases, with new / renovated HVAC systems being brought on-line at varying points in time during the project duration. The Owner will be retaining full use and occupancy of areas served by HVAC sub-systems not being renovated under the current phase. Near the end of each phase of equipment replacement / system modification, the TAB Agent shall perform testing and balancing operations on the portion of the system added and/or modified and/or affected by the work of that phase.
- E. New Construction Phasing: The Project is being constructed in phases, with new HVAC systems being brought on-line at varying points in time during the project duration. Near the end of each phase of construction, the TAB Agent shall perform testing and balancing operations on the systems or portions of systems added or extended by the work of that phase.

1.9 COORDINATION

- A. The Division 23 Contractor shall coordinate the efforts of factory-authorized service representatives for systems and equipment, ATC System Installer, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.10 COORDINATION WITH THE COMMISSIONING AGENT

- A. A dedicated Commissioning Agent shall perform system certification and testing at the completion of construction. The TAB Agent shall assist the Commissioning Agent by supporting tasks as directed by the Commissioning Agent.
- B. Refer to Commissioning for HVAC Section
- C. In addition to the required work and coordination described in the Commissioning Section(s), the TAB Agent shall:
 - 1. Coordinate all balancing activities with the Commissioning Agent, and shall perform the herein described final inspection testing work as directed by the Commissioning Agent.

1.11 WARRANTY

- A. General Warranty: The project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- B. Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms or on NEBB forms stating that AABC or NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified Agent has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
 - 3. The warranty shall meet the requirements of the following program(s):
 - a. AABC - National Project Performance Guarantee
 - b. NEBB - Conformance Certification

PART 2 - PRODUCTS

2.1 DUCT TEST HOLES AND HOLE PLUGS

- A. Refer to Division 23 Section "Air Duct Accessories" for instrument test holes for ducts constructed to pressure classes exceeding 2" w.g. positive pressure, and for ducts of welded seam and joint construction.
 - 1. The TAB Agent shall review the Division 23 Contractor's ductwork shop drawings and shall prescribe the location, spacing, and quantity of all required instrument test holes.
- B. For ducts not utilizing welded seam and joint construction and for those constructed for 2" w.g. positive pressure class or less, the TAB Agent shall provide tapered, round LDPE plastic plugs with center pull-tabs to seal holes drilled in ductwork for measuring purposes. Provide Caplugs "CPT" series or approved equal. Holes drilled in ducts shall be no larger than 1/2" diameter.

2.2 INSULATION REPAIR MATERIAL

- A. Refer to Division 23 Section "HVAC Duct Insulation" for insulation, jackets and tapes to repair insulation and insulation jackets removed or damaged during testing and balancing work.
- B. Except where ducts are exposed in finished spaces, label the location of test holes on insulated ducts at the location of the insulation jacket repair with a permanent marker stencil or stick-on vinyl label.

PART 3 - EXECUTION

3.1 TESTING, ADJUSTING, AND BALANCING SCOPE

- A. Pre-Demolition Testing:
 - 1. See drawings for pre-demolition testing requirements.

- B. Post-Construction Airflow Balancing: Include in the airflow adjustment and balancing scope, no less than the following:
 - 1. All new systems and new equipment.
 - 2. Existing systems and equipment as noted on the Drawings.
 - 3. All existing system fans (e.g. independent fans, fans in air handling equipment, etc.) associated with ductwork systems that have been altered under the Project to any degree.
 - 4. All existing duct dampers, and diffusers on ductwork systems that have been altered under this Project to any degree.

3.2 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Verify that balancing devices, such as manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - 2. Identify locations where instrument test holes are required and coordinate with the sheet metal shop drawings and coordination drawings so that the required test holes are installed prior to beginning testing and balancing operations.
 - 3. Examine the project phasing plans.
- B. Examine approved submittal data of HVAC systems and equipment.
 - 1. Verify the balancing and/or flow verification requirements of the equipment provided with the manufacturers or manufacturer's representatives.
- C. Examine equipment performance data, including fan curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 1. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine system and equipment test reports.

- F. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- H. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine equipment for installation and for properly operating safety interlocks and controls.
- J. Examine system pumps to ensure absence of entrained air in the suction piping.
- K. Examine automatic temperature system components to verify the following:
 - 1. Dampers and other controlled devices operate by the intended controller.
 - 2. Dampers are in the position indicated by the controller.
 - 3. Integrity of dampers for free and full operation and for tightness of fully closed and fully open positions.
 - 4. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 5. Sensors are located to sense only the intended conditions.
 - 6. Sequence of operation for control modes is according to the Contract Documents.
 - 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 8. Interlocked systems are operating.
 - 9. Changeover from heating to cooling mode occurs according to design values.
- L. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.3 PREPARATION

- A. Complete system readiness checks. Verify, at the minimum, the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance dampers are open.
 - 5. Fire and smoke dampers are open.
 - 6. Ceilings are installed in areas where air-pattern adjustments are affected by the ceiling.
 - 7. Air terminal inlets and outlets (grilles, diffusers, etc.) have been fitted with their specified accessories, such as dampers, neck baffles, and control grids, and have been adjusted to the required throw pattern.
 - 8. Access to balancing devices is provided.
 - 9. Windows and doors can be closed so design conditions for system operations can be met.
 - 10. Variable-frequency controller startup is complete and safeties are verified.
 - 11. Fans are operating, free of vibration, and rotating in the correct direction.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in the latest edition of AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", and this Section.
 - 1. The content of this Section shall be considered supplemental to the referenced standards, however in the event of a direct conflict between the methods prescribed by this this Section and those contained in the referenced standards, the TAB Agent shall request a clarification from the Architect / Engineer. The higher cost method / procedure shall be carried in the bid price.
- B. Access and Repair: Cut insulation on ducts to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes as specified elsewhere in this Section and patch insulation and jacketing with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
 - 1. Do not cut or otherwise penetrate equipment cabinets or the top of exterior ducts unless specifically permitted to do so by the Architect / Engineer.
- C. Final Setting Marks: Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, fan-speed-control dials, and similar controls and devices, to show final settings.
- D. Provide all instruments, equipment, and materials needed for tests.

3.5 RE-TESTING

- A. If any deficiency in the installation of the work discovered during initial TAB operations prevents complete, accurate, and uncompromised testing, adjusting, and balancing of the systems, the TAB Agent shall report the deficiencies in writing. Any preliminary balancing work done with the deficiency still present shall will not be sufficient for acceptance, and re-testing and balancing shall be required after the deficiency has been fully corrected by the Contractor.
- B. If the fan and motor sheaves furnished with the fan prove to be inadequate for properly balancing the fan, the Division 23 Contractor shall replace the sheaves at no additional Cost to the Owner, and the TAB agent shall re-test and balance the fan with the new sheaves.

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For multiple zone variable-air-volume systems, develop a plan to simulate diversity.

- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
 - 1. Do not use readouts from airflow measuring stations as report data. The Agent shall independently measure airflow rates.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.
- M. Place systems in operation with filters installed and control systems complete and operating. Temporarily block filters to simulate dirty filter pressure drop (obtain dirty filter pressure drop from drawing schedules. If not stated, contact design engineer to obtain). Balance systems to design ratings.
- N. On multiple zone variable-air-volume systems, determine the lowest practical supply duct static pressure setpoint while maintaining required pressure at the most aerodynamically remote control air terminal units (e.g. zone damper). Set static pressure set points to ensure the most hydraulically remote terminal unit(s) can achieve design flow. Measure flow at each terminal unit individually to verify scheduled design flow is achieved at the lowest possible differential pressure set point. Reset the duct pressure set point and re-measure flow at each terminal unit until the lowest set point is achieved. Coordinate with DDC system sub-contractor's programmer.
- O. Verify the accuracy and calibration of air flow measuring stations by taking traverse readings across associated ducts, or other measurements as required.
 - 1. Do not use readouts from airflow measuring stations as report data. The Agent shall independently measure airflow rates.
- P. Variable Speed Drive Adjustments: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for additional information related to variable frequency drive tests and setting adjustments.
 - 1. For direct-drive fans equipped with variable frequency drives, determine the output frequency of the drive required to achieve the scheduled (design) fan performance.
 - a. Note that that the required output frequency is very often above 60 Hz.

- b. Record the required output frequency at the design fan performance and measure voltage and amps of the motor for each phase.
 - c. Additionally, determine and record the maximum output frequency that results in operation of the motor at 95% of the motor nameplate ampacity or operation of the fan just above breakdown torque of the motor, whichever is reached first.
 - d. Report the recorded test results to the Engineer.
 - e. Re-set the VFDs maximum output speed to the value recommended by the Architect / Engineer.
 - f. Verify that the final settings corresponds to, or is lower than, the maximum RPM for the fan wheel class, and will prevent motor overload in normal operation.
- Q. Speed adjustment procedures for ECM motors controlled through an analog output from the DDC system shall be similar to that described above for direct drive fans powered through VFDs.
- 1. Use clamp-type electric meters that are capable of properly measuring non-linear current. Erroneous reading will occur otherwise.

3.7 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
- 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Compare contractor document values with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full

heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

- B. Where present, adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets (e.g. grilles and diffusers) and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminal inlets and outlets.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.8 PROCEDURES FOR MULTIPLE-ZONE VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all airflow control terminal units (e.g. VAV boxes) is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Calibrate system airflow measuring stations. If the airflow station manufacturer does not recommend field calibration, perform readings to verify that the stations are approximately accurate.
- C. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Verify that the system is under static pressure control.
 - 2. Select the airflow control terminal unit (e.g. VAV box) that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the

- terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Calibrate and balance each airflow control terminal unit for maximum and minimum design airflow as follows:
 - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
 - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
 - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
 - d. Adjust controls so that terminal is calling for minimum airflow.
 - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
 - f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
 - g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
 4. After airflow control terminal units have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
 - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 5. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
 6. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

- a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - b. Verify that airflow control terminal units are meeting design airflow under system maximum flow.
7. Re-measure the inlet static pressure at the most critical airflow control terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
8. Verify final system conditions as follows:
- a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
 - b. Re-measure and confirm that total airflow is within design.
 - c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
 - d. Mark final settings.
 - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
 - f. Verify tracking between supply and return / relief fans.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. Refrigerant Coils: Measure the following data for each coil:

- 1. Dry-bulb temperature of entering and leaving air.
- 2. Wet-bulb temperature of entering and leaving air.
- 3. Airflow.
- 4. Air pressure drop.
- 5. Refrigerant suction pressure and temperature.

3.10 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

- 1. Air Systems:
 - a. Measure and record the operating speed, airflow, and static pressure of each fan.
 - b. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - c. Check the refrigerant charge.
 - d. Check the condition of filters.
 - e. Check the condition of coils.
 - f. Check the operation of the drain pan and condensate-drain trap.
 - g. Check bearings and other lubricated parts for proper lubrication.
 - h. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

- B. Before performing testing and balancing of existing air distribution systems, inspect existing fans and air handling equipment that is to remain and be reused to verify that existing fans and air handling equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing air and distribution systems to the extent that existing systems are affected by the renovation work. Also refer to the Drawings for additional required balancing scope of existing systems.
1. Air Distribution Systems: Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 2. If calculations increase or decrease the air flow rates by more than 5 percent, make primary equipment (e.g. fan or pump) adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
 3. Air balance each air inlet and outlet.

3.11 DIFFUSER AND GRILLE SUPPLY PATTERN ADJUSTING

- A. Minimizing Drafts - Adjust all supply outlet diffusers, grilles, and registers to minimize drafts in all areas. Generally, this should consist of the following:
1. Adjust drum louvers, wall and duct mounted bar grilles and slot diffusers, and similar supply outlets as follows:
 - a. Adjust the horizontal spread provide full coverage across the occupied space, and to minimize the strength of the draft at the end of the jets.
 - b. For interior spaces or spaces with only roof exposure, adjust the vertical spread upwards to ensure that the supply jet does not fall into the occupied space before decaying to below 50 feet per minute. Perform measurements using a velocimeter, adjust, and retest until this criteria is met. Perform the above mentioned horizontal spread adjustments before adjusting the vertical pattern.
 - c. For exterior spaces, adjustment shall be made to provide the most nearly-horizontal pattern that still ensures the supply air jet reaches the occupied zone during conditions of peak or near-peak heating (i.e. during the warmest supply air condition).
 2. Verify that ceiling supply diffusers indicated on the drawings for 1, 2, or 3-way patterns achieve the required throw directions. Re-arrange and adjust louvers and deflectors as required. For some styles of diffusers, this will require verifying that the diffusers have the required sectorizing baffles installed.

3. Ceiling diffusers with moving center cones or deflection tabs for horizontal-vertical pattern adjustment shall be set to provide the most horizontal pattern that still ensures the supply air reaches the occupied zone during conditions of peak or near-peak heating (i.e. during the warmest supply air condition).
 4. Ceiling mounted slot diffusers shall be adjusted to produce a horizontal pattern along the ceiling, unless a vertical pattern is specifically indicated on the drawings. This adjustment shall be made prior to balancing the diffuser.
- B. Adjustments shall be made to prevent drafts on space temperature sensors controlling heating and cooling equipment.

3.12 FLOW MEASUREMENT DEVICE VERIFICATION AND CALIBRATION

- A. Flow measurement verification shall be performed in situ without removing flow measurement devices from their installed positions. The process requires a coordinated effort between the TAB Agent and the controls sub-contractor performing the work of Division 23 Section "Instrumentation and Control for HVAC". The verification process shall generally consist of the TAB Agent measuring flow and comparing the results to the values registered by the flow measurement device, and performing field calibration of the flow measurement device where deemed necessary by the Architect / Engineer. Perform verification after initial testing and balancing efforts are complete. For constant flow systems, perform verification at design flow rates. For variable flow systems, perform verification at no less than four (4) operating conditions, including maximum / design flowrate, minimum flowrate, and two (2) additional points spaced evenly between the maximum and minimum flowrates. For variable flow systems, where differential pressure or velocity pressure measurement is performed, utilize multiple a differential pressure meters with a ranges appropriate for each specific reading.
1. Airflow Measurement Stations (Specific Requirements): Verify the accuracy of all airflow measurement stations independently of other airflow measurement stations, with the exception of individual fan inlet stations on fan arrays need not be tested individually, as they may be tested as a single group. Measure flow by performing multi-point duct or air system unit cabinet flow traverses wherever possible. Do not sum airflow readings taken from multiple VAV terminal units or air inlets and outlets.
- B. The TAB Agent shall submit preliminary comparative results to the Architect / Engineer along with details describing the methods and location of field measurement. Also include commentary on the relative accuracy of the field measurement based on field conditions and constraints. The controls sub-contractor shall provide for inclusion in the report information regarding the installed condition of the flow measurement device including distances to duct/pipe elbows, etc., comparing the installation to the published recommendations of the flow measurement device manufacturer.
- C. At the request of the Architect / Engineer or the Owner, assist the controls sub-contractor performing the work of Division 23 Section "Instrumentation and Control for HVAC" in performing a field calibration of the flow measurement device as recommended by the flow measurement device manufacturer.

3.13 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Fans and Equipment with Fans: Zero to plus 10 percent, when tested with filter pressure drop simulated at dirty conditions.
 - 2. Air System Minimum Outdoor Air Intake: 100% to 110% of design.
 - 3. Air Outlets and Inlets (Diffusers and Grilles): Minus 10 percent to plus 10 percent.
 - 4. Terminal Units (e.g. zone dampers, etc.): Minus 5 percent to plus 5 percent.

3.14 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. For phased construction, submit a separate final report for each phase, as each phase is balanced and is accepted by the Owner.
- C. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- D. Final Report Contents: In addition to report data specified in paragraphs below, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
 - 5. All required measurements and tests described in Articles above, but not listed in paragraphs below.
- E. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB firm who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 12. Nomenclature sheets for each item of equipment.
 13. Data for airflow control terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils and other heat exchange devices.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air static-pressure controller.
 - g. Other system operating conditions that affect performance.
- F. Airflow measurement device verification and calibration result test reports.
- G. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Airflow control terminal units.
 4. Airflow terminal inlets and outlets.
 5. Balancing stations.
 6. Position of balancing devices.
- H. Rooftop Unit and Similar Air System Equipment Test Reports: For -air systems with heat transfer devices (coils, etc.) include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 2. Motor Data:
 - a. Make and frame type and size.

- b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
3. Air-Side Test Data (Indicated and Actual Values), with pressures and airflow rates presented on a diagram of the unit:
- a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat coil static-pressure differential in inches wg (Pa).
 - g. Cooling coil static-pressure differential in inches wg (Pa).
 - h. Re-heating coil static-pressure differential in inches wg (Pa).
 - i. Outside airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outside-air damper position.
 - l. Return-air damper position.
- I. Refrigerant-Coil Test Reports: As a supplement to the report for the associated air system, for refrigerant coils installed in rooftop units, and similar equipment, include the following:
- 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Air pressure drop in inches wg (Pa).
 - c. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - d. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Refrigerant expansion valve and refrigerant types.
 - h. Refrigerant suction pressure in psig (kPa).
 - i. Refrigerant suction temperature in deg F (deg C).
- J. Gas-Fired Heat Apparatus Test Reports: As a supplement to the report for the associated air system, for fuel fired burners installed in rooftop units, and similar equipment, include the following in addition to manufacturer's factory startup equipment reports:
- 1. Unit Data:
 - a. System identification.

- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btuh (kW).
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches (mm), and bore.
- n. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).

2. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm (L/s).
- b. Entering-air temperature in deg F (deg C).
- c. Leaving-air temperature in deg F (deg C).
- d. Air temperature differential in deg F (deg C).
- e. Entering-air static pressure in inches wg (Pa).
- f. Leaving-air static pressure in inches wg (Pa).
- g. Air static-pressure differential in inches wg (Pa).
- h. Low-fire fuel input in Btuh (kW).
- i. High-fire fuel input in Btuh (kW).
- j. Manifold pressure in psig (kPa).
- k. High-temperature-limit setting in deg F (deg C).
- l. Operating set point in Btuh (kW).
- m. Motor voltage at each connection.
- n. Motor amperage for each phase.
- o. Heating value of fuel in Btuh (kW).

K. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.
- g. Sheave make, size in inches (mm), and bore.
- h. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).

2. Motor Data:

- a. Make and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.

- d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 - g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- L. Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
- a. System, fan and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated airflow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual airflow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).
- M. Air-Terminal-Device Reports (Grilles, Diffusers, etc.):
1. Unit Data:
- a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft. (sq. m).
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary airflow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).

- e. Final airflow rate in cfm (L/s).
- f. Final velocity in fpm (m/s).
- g. Space temperature in deg F (deg C).

N. Airflow Control Terminal (e.g. zone damper) Reports:

1. Unit Data:

- a. Make and Model Number
- b. System and air-handling unit identification.
- c. Location and Room(s) served.
- d. Inlet duct size.
- e. Supply outlet numbers connected from system diagram.

2. Test Data (Indicated and Actual Values):

- a. Heating minimum airflow rate in cfm
- b. Cooling minimum airflow rate in cfm
- c. Maximum (cooling) airflow rate in cfm
- d. Induced air cfm (if fan powered) during fan operation at each of the above primary air states in cfm.
- e. Static pressure drop through terminal (including coil, if present) at maximum airflow.
- f. Minimum and maximum flow calibration factors determined for the unit inlet velocity sensor.

O. Refrigerant Compressor and Condenser Reports: For refrigerant side of unitary systems, include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Unit make and model number.
- d. Compressor make.
- e. Compressor model and serial numbers.
- f. Refrigerant type and weight in lb (kg).
- g. Low ambient temperature cutoff in deg F (deg C).

2. Test Data (Indicated and Actual Values):

- a. Inlet-duct static pressure in inches wg (Pa).
- b. Outlet-duct static pressure in inches wg (Pa).
- c. Entering-air, dry-bulb temperature in deg F (deg C).
- d. Leaving-air, dry-bulb temperature in deg F (deg C).
- e. Control settings.
- f. Unloader set points.
- g. Low-pressure-cutout set point in psig (kPa).
- h. High-pressure-cutout set point in psig (kPa).
- i. Suction pressure in psig (kPa).

- j. Suction temperature in deg F (deg C).
 - k. Condenser refrigerant pressure in psig (kPa).
 - l. Condenser refrigerant temperature in deg F (deg C).
 - m. Oil pressure in psig (kPa).
 - n. Oil temperature in deg F (deg C).
 - o. Voltage at each connection.
 - p. Amperage for each phase.
 - q. Kilowatt input.
 - r. Crankcase heater kilowatt.
 - s. Number of fans.
 - t. Condenser fan rpm.
 - u. Condenser fan airflow rate in cfm (L/s).
 - v. Condenser fan motor make, frame size, rpm, and horsepower.
 - w. Condenser fan motor voltage at each connection.
 - x. Condenser fan motor amperage for each phase.
- P. Air-to-Air Heat-Recovery Heat Exchanger (Energy wheel, heat pipe, etc.) Reports: As a supplement to the report for the air handling unit, etc. in which the air to air heat recovery heat exchanger is installed, include the following:
1. Energy Recovery Heat Exchanger Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and type.
 - e. Model and serial numbers.
 2. Energy Wheel Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full load amperage and service factor.
 3. Energy Recovery Heat Exchanger Test Data (Indicated and Actual Values):
 - a. Total exhaust airflow rate in cfm (L/s).
 - b. Purge exhaust airflow rate in cfm (L/s).
 - c. Outside airflow rate in cfm (L/s).
 - d. Total exhaust fan static pressure in inches wg (Pa).
 - e. Total outside-air fan static pressure in inches wg (Pa).
 - f. Pressure drop on each side of recovery wheel in inches wg (Pa).
 - g. Exhaust air temperature entering in deg F (deg C).
 - h. Exhaust air temperature leaving in deg F (deg C).
 - i. Outside-air temperature entering in deg F (deg C).
 - j. Outside-air temperature leaving in deg F (deg C).
 - k. Calculate sensible and total heat capacity of each airstream in MBh (kW).

Q. Instrument Calibration Reports:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

3.15 ADDITIONAL TESTS

- A. After acceptance of the final balancing report, and within one year of substantial completion, provide up to 8 hours of on-site time for additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions. This allowance may be required over as many as two (2) separate site visits. "Additional testing and balancing" meaning work not otherwise required by the Contract Documents.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - HVAC DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Ductwork" for duct liner.
 - 2. Division 23 Section "Common Work Results for HVAC" for definitions of some terms used in this Section.
 - a. Definition of the term 'Mixed Air': An airstream containing, in some or all system operating modes, a fraction of outdoor air mixed with return air.

1.2 SUMMARY

- A. This Section includes duct and plenum insulation; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Application of field-applied jackets.
 - 2. Applications at dampers and other control devices.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed a craft training program offered by the Contractor, insulation material manufacturer, or trade association relating to the installation of duct insulation for commercial, industrial and institutional applications. Installers shall also have no less than one (1) year of relevant experience.
- B. Installation Standards: The application of insulation shall conform to the Midwest Insulation Contractors Association's (MICA) "*National Commercial and Industrial Insulation Standards*", 8th Edition, except where the content of this Section conflicts.

- C. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, for all insulation and jacketing materials used indoors.
- D. Minimum Insulation Thicknesses and R-Values: Conform to requirements of ASHRAE Standard 90.1- 2010 and the 2012 International Energy Conservation Code (IECC), or the requirements of this Section, whichever is most demanding.
- E. Exterior Duct Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups according to the following requirements, using materials indicated for the completed Work:
 - 1. Include the following mockups for exterior ductwork:
 - a. One (1) 5-foot section of rectangular straight duct.
 - b. One (1) 90-degree square elbow and one 90-degree radius elbow.
 - c. Four (4) supports or hangers.
 - 2. Build mockups with cutaway sections to allow observation of application details for insulation materials, mastics, attachments, and jackets.
 - 3. Build mockups in the location indicated or, if not indicated, as directed by Architect/Engineer.
 - 4. Notify Architect/Engineer seven days in advance of dates and times when mockups will be constructed.
 - 5. Obtain Architect/Engineer's approval of mockups before starting insulation application.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed.
 - 8. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. Protect materials from dirt and water. If insulation materials are dirtied or wetted, they shall not be installed, or shall be removed from the ductwork if wetted or soiled after installation.

1.6 COORDINATION

- A. Coordinate clearance requirements for insulation application during the preparation of ductwork shop drawings and coordination drawings, and during ductwork system installation.

1.7 SCHEDULING

- A. Schedule insulation application after successful leakage and pressure testing duct systems, and acceptance by the Architect / Engineer. Insulation application may begin only on segments of ducts that have satisfactory test results.
- B. Schedule the application of insulation on cold duct systems to occur during the winter months, or with the cooling system de-energized. Substrates shall be completely dry at the time of application. Do not restore cooling service until the insulation installation is complete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Glass Mineral-Fiber Insulation:
 - a. CertainTeed Corp.
 - b. Johns Manville, Inc.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens-Corning Fiberglas Corp.
 - 2. Flexible Elastomeric Insulation:
 - a. Armacell LLC
 - b. K-Flex USA
 - c. Aeroflex USA

2.2 INSULATION MATERIALS

- A. General Requirements: All insulation materials shall comply with the following:
 - 1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
 - 2. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
 - 3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
 - 4. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- B. Glass Mineral-Fiber Board Thermal Insulation for Interior Use: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, 3.0 PCF density, with a factory applied white, paintable, all-service jacket (ASJ) manufactured from kraft paper, fiberglass reinforcing scrim, and aluminum foil backing, complying with ASTM C 1136, Type I.

1. 3.0 PCF materials shall have a maximum thermal conductivity of 0.23 Btu-in./h-ft²- °F.
 2. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
- C. Glass Mineral-Fiber Board Thermal Insulation for Exterior Use: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, 6.0 PCF density, with a factory applied foil faced (FSK) jacket manufactured from aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
1. 6.0 PCF materials shall have a maximum thermal conductivity of 0.22 Btu-in./h-ft²- °F.
 2. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
 3. Compressive Strength: 200 lb./sq. ft. at 10% deformation, when tested in accordance with ASTM C 165.
 4. less.
- D. Glass Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type III, 1-1/2 PCF density, without facing and with aluminum, foil-scrim-kraft (FSK) jacket manufactured from kraft paper backing, reinforcing fiberglass scrim, and aluminum foil; complying with ASTM C 1136, Type II.
1. 1-1/2 PCF materials shall have a maximum thermal conductivity of 0.24 Btu-in./h-ft²- °F.
 2. Conductivity ratings shall be at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
- E. Flexible Elastomeric Insulation: NBR/PVC or EPDM-based, closed-cell, flexible elastomeric insulation. Comply with ASTM C 534, Type II for sheet materials.
1. Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ASTM E 84, latest revision.
 2. Materials shall have a maximum thermal conductivity of 0.265 Btu-in./h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
 3. Materials shall have a maximum water vapor transmission of 0.05 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.
 4. Adhesive: As recommended by insulation material manufacturer.

2.3 JACKET TAPES

- A. For use on factory jackets.
- B. FSK Jacket Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches (75 mm).
 2. Thickness: 6.5 mils (0.16 mm).
 3. Adhesion: 90 ounces' force/inch (1.0 N/mm) in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. All-Service Jacket (ASJ) Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces' force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.4 FIELD-APPLIED WEATHERPROOFING JACKETS

- A. Exterior Weatherproofing Jacketing Membrane: ASTM 4637, Type I EPDM roofing membrane; minimum 60 mils thick. Provide Carlisle "Sure-White" EPDM or Carlisle "Sure-Seal" standard black-colored EPDM, or approved equal from Firestone or Johns Manville.
1. Bonding Adhesive: Manufacturer's standard, low-VOC (660 g/L or less), or water based.
 2. Splice Tape: Manufacturer's standard, factory and field applied, with priming solution.
 3. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane.
 4. Pressure Sensitive Flashing: 60 mil thick EPDM bonded to a 30 mil thick, fully cured pressure sensitive adhesive.
- B. Exterior Weatherproofing Insulation Jacketing Tape: UV-resistant aluminum foil and polymer laminate bonded to rubberized asphalt, and coated with a low temperature acrylic adhesive. Water vapor permeability rating shall be zero (0.0) perms as per ASTM E 96. Provide one of the following products:
1. Polyguard Products, Inc. - Alumaguard All-Weather.
 2. 3M - VentureClad Plus 1579GCW-E.
 3. MFM Building Products Corp. Flex-Clad-250 in a white finish.

2.5 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd.
1. Tape Width: 4 inches.
- B. Bands: 3/4-inch-wide, in one of the following materials compatible with jacket:
1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 2. Galvanized Steel: 0.005 inch thick.
 3. Aluminum: 0.007 inch thick.

- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 1. Welded Pin Holding Capacity: 100 lb. for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel or stainless steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated. Stainless steel pin and washer materials shall be used on stainless steel or aluminum ducts.
 - 1. Adhesive: Single component moisture curing adhesive recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
 - 2. Peel and stick (self-adhesive) type pins are not acceptable.

2.6 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040-inch (1.0 mm) thick, minimum 2 by 2 inch (50 by 50 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

2.7 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.
- B. Acoustical Sealant: UL 762. Non-hardening, permanently flexible formulation to provide a pliable seal against airborne sound.
 - 1. Provide BRD "Hush Sealant" model HSAC-100, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Ensure that insulation is clean and dry, and in good mechanical condition with all factory applied vapor or weather barriers intact and undamaged.
- B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements during and after installation for a minimum period of 24 hours.
- C. On cold surfaces where a vapor barrier is required (e.g. supply ductwork), insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- D. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- E. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- F. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- G. Apply multiple layers of insulation with longitudinal and end seams staggered.
- H. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- I. Keep insulation materials dry during application and finishing.
- J. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- K. Apply insulation with the least number of joints practical.
- L. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- M. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

- N. Insulation Terminations and Penetrations: For insulation application where vapor retarders are indicated, seal ends and cut penetrations with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- O. Install corner angles on external corners of insulation on ductwork in exposed mechanical or finished spaces and outside the building before covering with jacketing.
- P. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- Q. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- R. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
 - 1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
 - 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- S. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Seal insulation to roof flashing with vapor-retarder mastic.
- T. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- U. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- V. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
 - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 GLASS MINERAL-FIBER INSULATION INSTALLATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives to duct, plenum, fittings and transitions surfaces according to manufacturer's recommended coverage rates.
 2. Install anchor pins and speed washers on all four sides of horizontal ducts and all four sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3-inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3-inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 3. Impale insulation over anchors and attach speed washers.
 4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 6. Overlap un-faced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
 7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
 9. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers on all sides of ducts and plenums.
1. Apply adhesives to duct, plenum, fittings and transitions surfaces according to manufacturer's recommended coverage rates.
 2. Space anchor pins as follows:
 - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3-inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3-inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 3. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
5. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulation on round and flat oval duct shall be back-scored to conform to duct profile.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC SHEET INSULATION INSTALLATION

- A. Seal all seams, butt joints, termination points, and open ends with the manufacturer's approved sealant to prevent air / moisture intrusion.
- B. Insulation shall be adhered directly to clean, oil-free surfaces with a full coverage of spray adhesive. The adhesive shall be as recommended by the manufacturer.
- C. Sheet insulation shall be cut and mitered as necessary to fit the shape of the ducts.
- D. Butt-edge seams shall be adhered using a sealing adhesive by the compression fit method to allow for expansion/contraction. Leave a 1/2"-wide uncoated border at the butt-edge seams on the duct surface and the insulation surface. Overlap the insulation 1/4" at the butt-edges and compress the edges into place. Apply adhesive to the butt-edges of the insulation.
- E. Standing metal duct seams and flanges shall be insulated with the same insulation thickness as installed on the duct surface. Seams and flanges may be covered using strips of sheet insulation or half sections of tubular pipe insulation of the same material with miter-cut ends. Standing seams and flanges shall be adhered using adhesive recommended by the manufacturer.
- F. Insulation seams shall be staggered when applying multiple layers of insulation.
- G. Finish over exterior installations with the field applied protective coating specified herein.

3.6 INSTALLATION OF ACOUSTICAL LAGGING

- A. Generally comply with the requirements above for installing blanket type insulation, except as altered or supplemented by this Article.
- B. Where insulated ducts pass through sleeves or openings, the full specified thickness of the insulation shall pass through the sleeve or opening. Where fire-stopping material is used in fire rated walls, butt insulation tight to fire and smoke stopping material, or to collar, at wall and floor

penetrations. Where fire and smoke stopping material does not extend full depth of sleeve, insulation shall extend inside sleeve to butt against fire and smoke stopping material.

- C. Lagging coverage shall be 100% of the covering area without air gaps.
- D. Acoustical sealant shall be applied everywhere necessary to achieve an air tight finished installation.
- E. Corners of rectangular duct treatment shall be caulked with acoustical sealant and taped with FSK jacketing tape.
- F. All other joints and seams shall have minimum 1-1/2-inch overlap of barrier layer only onto next piece with acoustical sealant and FSK tape.
- G. Banding, adhesive and mechanical fasteners such as stick pins shall be used to attach and support the material in place.
 - 1. Fasteners and banding shall not be overly tight so as to compress decoupling insulation.

3.7 WEATHERPROOFING JACKET INSTALLATION

- A. Do not use the weatherproofing jackets as a substitute for banding, pinning or other means of securely attaching insulation and underlying materials. Apply jacket to clean, dry, smooth-faced insulation with a factory FSK type jacket. Insulation pin washers shall be covered with a 4-inch (101.6-mm) square piece of smooth foil tape prior to jacketing the ductwork to prevent the puncture of the outer membrane by the fasteners.
- B. Apply waterproofing jacketing tape in accordance with manufacturer's instructions. The contractor shall verify and obtain the latest installation instructions from the jacketing tape manufacturer prior to any work being done.
- C. Ducts shall be sealed in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", 3rd Edition (2005) requirements for 'Seal Class A' and pass the specified leakage tests, prior to the installation of jacket. Leaking ducts negatively affect the performance characteristics of jacket and may result in ballooning, and failure of the jacket installation, which will require complete reinstallation of the insulation and jacketing tape system by the Contractor at no additional cost to the Owner if it occurs within 1 year of Substantial Completion.
 - 1. On positively pressurized ducts, provide jacketing tape manufacturer's recommended vents on the underside of the ductwork, but only with the prior approval of the Architect / Engineer.
- D. Apply jacketing tape and EPDM membrane jacket, and EPDM adhesives in accordance with manufacturer's air, material, and surface temperature requirements. Apply firm, uniform pressure with hand roller to entire membrane to ensure proper adhesion. Concentrate pressure at seams and on underside of ductwork.

- E. EPDM Membrane Installation:
1. Unroll membrane EPDM membrane jacket and allow to relax for at least 30 minutes before installing.
 2. Adhering EPDM Membrane Jacket to Duct Insulation: Apply bonding adhesive to insulation substrate and underside of membrane at rate required by manufacturer, and allow to partially dry before installing membrane. Do not apply to splice area of membrane. Firmly roll the entire surface of the membrane.
 3. EPDM Seams: Field seams (lap splices) shall be made as recommended by the membrane manufacturer for a fully adhered type installation with field splices.
 - a. Clean both faces of splice areas with primer and apply splicing tape or splicing cement.
 - b. Firmly roll side and end laps of overlapping membrane to ensure a watertight seam installation.
 - c. Apply lap sealant and seal exposed edges of membrane.
 - d. Apply a continuous bead of in-seam sealant before closing splice.
 - e. Finish over the completed splice with pressure sensitive EPDM flashing.
- F. Verify that the ductwork is pitched or that the insulation is built up with sloped tops in order to shed water and prevent ponding water, prior to applying the jacket material.
- G. Apply jackets in a "shingle fashion" to shed water over, not against laps. Apply minimum 4-inches side laps and minimum 6-inches end laps.
- H. Pin the weatherproofing jacketing tape applied to the underside of rectangular ductwork and elsewhere as recommended by the tape manufacturer. Cover pin heads with tape patches.

3.8 DUCT SYSTEM APPLICATIONS - GENERAL REQUIREMENTS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Field-insulate the following plenums and duct systems listed below, and those listed in the application schedule articles located elsewhere in this Section:
1. Indoor concealed supply- mixed air-, and outside-air ductwork.
 2. Indoor exposed supply-, mixed air-, and outside-air ductwork.
 3. All ductwork located outdoors and exposed to weather.
 4. Ducts scheduled to receive insulation in the schedules at the end of this Section.
- C. Insulate, as specified for the connecting ductwork, the outside of damper frames, silencers, duct coil casings, and similar duct accessories and equipment that form an air conveying portion of the duct wall, except for access doors and smoke, fire, and combination smoke-fire damper sleeves.
- D. Items Not Field-Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Indoor ducts in conditioned or indirectly conditioned locations indicated or specified to receive duct liner. Refer to Division 23 Section "Ductwork" for those ducts specified to

receive liner. Also refer to the Drawings for other ductwork required to receive liner. Exceptions are as follows:

- a. Exception: Ducts located outdoors, or located in an unconditioned attic, loft, crawlspace, or similar area outside the building's insulated thermal envelope, shall be provided with exterior insulation and jackets specified in this Section, even if they are also indicated to receive duct liner.
 - b. Exception: Ducts specified to receive sound lagging shall be provided with the lagging, even if they are also indicated to receive duct liner.
2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums, casings, air terminal units (i.e. VAV boxes), and filter boxes and sections.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Testing agency labels and stamps.
 7. Nameplates and data plates.
 8. Factory insulated access panels and doors in air-distribution systems.
 9. Motorized damper shafts and manual volume damper quadrants.
 10. Life Safety Damper sleeves unless required by the damper's UL listing or installation instructions.
 11. Factory pre-insulated double-wall ducts. Refer to Division 23 Section "Ductwork" and the Drawings for those ducts required to be double wall.

3.9 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Refer to Division 23 Section "Common Work Results for HVAC" for definitions of 'conditioned' and 'unconditioned' spaces, as well as 'exposed' and 'concealed' installations.
- B. Minimum R-Values scheduled below are in units of h-ft²- °F./ Btu, at 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518. For blanket insulation, they shall be 'as-installed' R-values and thicknesses with 25% compression.
 1. Provide additional insulation thickness than the minimum thicknesses scheduled below if required to meet the minimum R-value indicated.
- C. Service: Supply-air, mixed air, and outside-air ducts, concealed in indirectly conditioned spaces (e.g. ceiling plenums, shafts, etc.).
 1. Material: 1-1/2 PCF glass mineral-fiber blanket with aluminum foil-scrim-kraft (FSK) jacket.
 2. Minimum Thickness: 1-1/2 inches.
 3. Number of Layers: One.
 4. Vapor Retarder Required: Yes.
 5. Minimum R-Value: 4.8
- D. Service: Supply-air, return-air, mixed air, and outside-air ducts, exposed in Mechanical Equipment Rooms and similar un-finished, but indirectly conditioned, spaces.

1. Material: Rigid glass mineral-fiber board, 3 PCF density, with white, paintable all-service jacket (ASJ). Insulation on round and flat oval duct shall be back-scored to conform to duct profile.
 2. Minimum Thickness: 1 inches.
 3. Number of Layers: One.
 4. Vapor Retarder Required: Yes.
 5. Minimum R-Value: 4.3
- E. Service: Supply-air, return air mixed air, and outside air ducts, exposed in finished, conditioned spaces.
1. Material: Rigid glass mineral-fiber board, 3 PCF density, with white all-service (ASJ) jacket. Insulation on round and flat oval duct shall be back-scored to conform to duct profile.
 2. Minimum Thickness: 1 inches.
 3. Number of Layers: One.
 4. Vapor Retarder Required: Yes.
 5. Minimum R-Value: 4.3
 6. NOTE: Refer to the Drawings and Division 23 Section "Ductwork" for those ducts required to be double wall or receive duct liner instead of the above specified board insulation.
- F. Service: Portions of exhaust duct and plenum systems between an isolation motorized or backdraft damper and the duct system termination at a louver, gravity ventilator, gooseneck, or similar discharge opening to the exterior.
1. Insulate as specified above for outdoor air ductwork.
- G. Service: Sound attenuation.
1. Material: Acoustic lagging with de-coupling insulation. Lagging shall substitute for any elsewhere specified external thermal insulation.
 2. Minimum Thickness: 1-1/2 inches. Additional un-faced glass mineral fiber insulation shall be provided between the duct and the de-coupled sound lagging as required to yield this total thickness.
 3. Vapor Retarder Required: Yes (but may be omitted on return and exhaust ducts).
 4. Minimum R-Value: 3.5.
 5. Application:
 - a. Locations indicated on the Drawings.
 - b. All portions of the supply and return duct system inside the building within 30 feet of each RTU connection, down all flow paths, as measured along the length of the centerline of the ductwork, except for those portions exposed in mechanical equipment rooms, or located outside.
 - 1) Exception: Air systems scheduled for a design capacity of less than 3,000 cfm.

3.10 OUTDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Service: All exterior ducts shall be double wall insulated ductwork as specified in Division 23 Section "Ductwork".

- B. Service: All exterior ducts.
 - 1. Material: 6.0 PCF density Glass mineral-fiber board with and FSK factory jacket.
 - 2. Minimum Thickness: 3 inches.
 - 3. Number of Layers: One or two. If two (2) layers are used, the inner layer shall be un-faced / un-jacketed.
 - 4. Vapor Retarder Required: Yes.
 - 5. Minimum R-Value: 13.5
 - 6. Installation and Weather-proofing:
 - a. The top of the exterior ductwork shall be built up with insulation in such a manner as to ensure a positive drain of rain water from the center to the sides of the ducts. The pitch of the built up section shall be 1/2 inch per foot / 4 percent slope / 2.5° angle. Care should be taken to assure that no low areas appear to prevent "pooling" of water. Board insulation shall be cut and mitered as necessary to fit the shape of the ducts. Insulation on round and flat oval duct shall be back-scored to conform to duct profile. Insulation shall be adhered to duct with mastic spread over entire sheet metal surface to assure a complete bond. Insulation board shall have seams and joints taped with 4-inch wide vapor barrier tape in strict accordance with the manufacturer's requirements.
 - b. Duct supports shall be located fully outside of the insulation and weatherproofing jacket. Support bearing points of rectangular duct shall be provided with minimum 6" wide strips of high-compressive strength polyisocyanurate board insulation in lieu of the above specified fiberglass. The strips shall be of the above specified thickness. Butt joints between the adjacent fiberglass board and polyisocyanurate insulation shall be sealed with mastic and FSK jacket tape. The polyisocyanurate insulation shall have an FSK outer jacket, a compressive strength of no less than 16 psi per ASTM D1621, and a thermal resistance of no less than R-6 as per ASTM C518. Polyisocyanurate insulation shall be Johns Manville 'XSPECT Isofoam APF Board', or approved equal.
 - c. OPTION 1 - Field Applied Weatherproofing Membrane Jacket: Finish over insulation shall be EPDM rubber membrane, securely glued in place (100 percent bonding adhesive coverage to both insulation and underside of membrane) with seams 4-inch overlapped and sealed for a completely watertight installation. Use the bonding adhesive and seam/splice joining system (primer, splice tape, lap sealant, and overlay of pressure sensitive flashing) recommended by the membrane manufacturer for a fully adhered type installation with field splices. Do not locate longitudinal seams on top surface of ducts. Insulation and membrane shall extend over curb counter-flashing where ductwork extends through roof curbs. Adjoining surfaces shall be waterproofed and flashed.
 - d. OPTION 2 - Field Applied Weatherproofing Insulation Jacketing Tape: Finish over insulation shall be weatherproofing insulation jacketing tape. Insulation jacketing tape shall be applied with seams 4-inch overlapped and sealed for a completely watertight installation. Do not locate longitudinal seams on top surface of ducts.

Insulation and jacketing shall extend over curb counter-flashing where duct extends through roof curbs. Adjoining surfaces shall be waterproofed and flashed.

- e. OPTION 3: In lieu of providing single wall exterior ductwork with the field-applied thermal insulation and weatherproofing materials as specified in this Section, the Contractor may provide Thermaduct™ and Thermaround™ ductwork systems. These ductwork systems shall be constructed from rigid closed cell phenolic board insulation with an FSK vapor barrier liner and an integral 1000 mil thick UV-stable vinyl or 0.032"-thick aluminum cladding on the exterior surface. The ductwork shall be constructed in accordance with the latest edition of the SMACNA Phenolic Duct Construction Standards (ANSI/SMACNA Standard 022). The insulation shall provide no less than R-12 thermal resistance with a full thermal break design, and shall be suitable for an internal temperature range from -15 deg. F. to 185 deg. F. and up to 5,000 fpm airflow velocity. The ductwork shall be UL 181 listed as a Class I air duct. Transverse field joints shall utilize a flanged and gasketed connection, and shall be finished over with factory insulation and cladding kit. Longitudinal joints shall be factory-made. Integral, internal reinforcement provided as required to meet the specified pressure class. The top of the ductwork shall be designed to shed water. The exterior ductwork shall be a single source installation, with all fittings and flanged duct connectors furnished by Thermaduct™, and the ductwork system shall be provided with a manufacturer's 10-year warranty against mechanical failure and water intrusion. The system shall be installed in strict compliance with the manufacturer's recommendations. The ductwork shall meet all other requirements specified in Division 23 Section "Ductwork" for the exterior ductwork, including pressure and leakage class performance ratings and fitting type requirements. Rectangular elbows shall be fitted with turning vanes. The Contractor shall solicit instruction from the local Thermaduct™ representative regarding the proper installation of the ductwork system prior to installation. The representative shall also visit the project site no less than once during the exterior duct system installation, and the representative shall issue a written report regarding their observations and findings. This report shall be submitted to the Architect/Engineer as an informational submittal.

- 1) Subject to compliance with requirements, the 'Dual-Tech' ductwork system as manufactured by PTM Manufacturing LLC may be provided for rectangular ducts shown on the Drawings in substitution for the above-specified rectangular Thermaduct™ ductwork system.

C. Service: All ducts.

- 1. Material: Closed cell flexible elastomeric sheet.
- 2. Minimum Total Thickness: 4 inches.
- 3. Minimum Number of Layers: No less than two (2), with seams staggered.
- 4. Minimum R-Value: 15.0
- 5. Installation and Weatherproofing:

- a. For exterior applications on rectangular ductwork, the top of the ductwork must be sloped to prevent "ponding" of water and ensure positive drainage from the center to the sides of the duct. Insulation may also be layered/ built up to achieve the same. At least a 1/2 inch per foot / 4 percent slope / 2.5° angle to the outer sides is required.

The duct insulation shall be constructed from the bottom up, with the top insulation sized to extend over the side insulation to form a watershed.

- b. Duct supports shall be located fully outside of the insulation and weatherproofing jacket. Support bearing points of rectangular duct shall be provided with minimum 6" wide strips of high-compressive strength polyisocyanurate board insulation in lieu of the above specified flexible elastomeric insulation. The strips shall be of the above specified thickness. Butt joints between the adjacent flexible elastomeric insulation and polyisocyanurate insulation shall be sealed with mastic. The polyisocyanurate insulation shall have an FSK outer jacket, a compressive strength of no less than 16 psi per ASTM D1621, and a thermal resistance of no less than R-6 as per ASTM C518. Polyisocyanurate insulation shall be Johns Manville 'XSPECT Isofoam APF Board', or approved equal.
- c. On round ductwork, insulation shall be wrapped (not stretched) around the duct. Insulation shall be completely adhered to the duct surface. Longitudinal seams shall be located on the lower half of any round ductwork.
- d. Butt edge seams shall be sealed and adhered in strict accordance with the manufacturer's requirements.
- e. After adhesive has fully cured, apply two (2) coats of the insulation manufacturer's recommended vinyl acrylic protective coating. The coating shall have a white color and shall be K-Flex '374 Protective Coating', or approved equal. Perform surface preparation and cleaning and coating application in strict accordance with the manufacturer's recommendations.
 - 1) Custom tint the coating. Utilize common pigment pastes normally used for tinting latex paint at a rate no greater than 4.3 oz./gallon, or as otherwise recommended by the coating manufacturer. The color shall be as selected by the Architect. Submit a tinted, finish-coated insulation sample to the Architect for approval prior to applying the coating to the work.

END OF SECTION 230713

SECTION 230800 - COMMISSIONING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Commissioning requirements unique to particular systems and equipment are included in the specification Sections that specify those systems and equipment.
 - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.2 SUMMARY

- A. This Section includes:
 - 1. General requirements for coordinating and scheduling commissioning.
 - 2. Commissioning meetings.
 - 3. Commissioning reports.
 - 4. Use of test equipment, instrumentation, and tools for commissioning.
 - 5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
 - 6. Commissioning tests and commissioning test demonstration.
 - 7. Adjusting, verifying, and documenting identified systems and assemblies.

1.3 EMPLOYMENT OF THE COMMISSIONING AGENT

- A. The cost to employ an independent Commissioning Agent (CxA) to provide commissioning services for this Project shall be included in the Division 23 Contractor's bid price.
 - 1. The CxA shall function as a subcontractor responsible to the Division 23 / HVAC sub-contractor. The CxA may not be a direct employee of any Prime or sub-contractor performing installation work under this Contract.
 - 2. The CX Agent shall function as a subcontractor responsible directly to the Single Prime Contractor (i.e. 'General' Contractor; not the Division 23 / HVAC Sub-Contractor). The CxA may not be a direct employee of any Prime or sub-contractor performing installation work under this Contract.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. The Division 23 Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities as specified in this Section, and including, but not limited to, the following:
1. Furnish approved submittals and operations and maintenance information for all equipment and systems to the CxA.
 2. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 3. Attend commissioning team meetings held on a monthly basis beginning after the commencement of mechanical/electrical construction work.
 4. Integrate and coordinate commissioning process activities with construction schedule.
 5. Review and accept construction checklists provided by the CxA.
 6. Complete construction checklists as Work is completed and provide to the CxA on a weekly basis.
 7. Create the start-up plan, perform startup of equipment and systems, and complete startup checkout reports.
 8. Review and accept commissioning process test procedures (both pre-functional and functional) provided by the CxA.
 9. Complete and participate in all commissioning process test procedures (both pre-functional and functional).
 10. Resolve issues identified in the Issues Log. Perform re-tests as required after corrections have been made.
 11. Require equipment suppliers to perform the work assigned to them in this Section.
 12. Require the ATC sub-contractor to perform the work assigned to them in this Section.
 13. Provide staff assigned to participate in commissioning, meeting the following:
 - a. HVAC and Electrical Testing Technician Qualifications: Technicians shall perform HVAC construction checklist verification tests, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
 - 1) Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associate's degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC&R systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC&R equipment, assemblies, and systems.
 - 2) Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.

1.5 DIVISION 23 EQUIPMENT SUPPLIER'S RESPONSIBILITIES

- A. As indicated in individual equipment Specification Sections, and including, but not limited to, the following:

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
2. Assist in equipment start-ups as indicated in Division 23 equipment specification Sections per agreements with the Division 23 Contractor.
3. Participate in the process of functionally testing factory packaged controls with the assistance of the Division 23 Contractor and at the direction of the ATC sub-contractor as indicated in Division 23 equipment specification Sections prior to functional testing by the CxA.
4. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to the Contract Documents in the base bid price to the Division 23 Contractor.
5. Provide information requested by CxA regarding equipment sequence of operation and testing procedures unique to the equipment supplied.
6. Review test procedures for equipment.
7. Attend commissioning meetings upon the request of the CxA or Division 23 Contractor.

1.6 ATC SYSTEM SUB-CONTRACTOR / SUPPLIER'S RESPONSIBILITIES

- A. The ATC system sub-contractor performing work under Section 230900 and 230993 shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities as specified in this Section, and including, but not limited to, the following:
 1. Furnish approved submittals and operations and maintenance information for all equipment and systems to the CxA.
 2. Attend commissioning meetings.
 3. Complete BAS pre-functional performance checks and complete the checklists.
 4. Perform all required self-checks and commissioning specified in Section 230900 prior to functional testing by the CxA.
 5. Lead the process of functionally testing factory packaged controls with the assistance of the Division 23 Contractor and equipment suppliers as specified in Division 23 equipment sections prior to functional testing by the CxA.
 6. Calibrate all BAS sensors and devices.
 7. Participate in the functional performance tests as directed by the CxA.
 8. Resolve issues identified in the Issues Log. Perform re-tests as required after corrections have been made.
 9. Provide staff assigned to participate in commissioning, meeting the following:
 - a. Building Automation System (BAS) Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
 - 1) Journey-level or equivalent skill level with knowledge of BAS, HVAC&R, electrical concepts, and building operations.
 - 2) Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.

1.7 COMMISSIONING AGENT'S RESPONSIBILITIES

- A. Review the Division 23 Contractor submittals and equipment operations and maintenance information for all systems and equipment to be commissioned.
- B. Review the Contract Documents to obtain familiarity with the Project and the project requirements.
- C. Request clarifications of the Design Professionals as required to determine the project's commissioning requirements.
- D. Organize and conduct commissioning team meetings held on a monthly basis.
- E. Inform the General Contractor of scheduling requirements, sequencing and milestones required to accomplish commissioning and balancing so that those can be incorporated into the master schedule prepared by the General Contractor.
- F. Prepare a Commissioning Plan. The Cx Plan will include no less than the following:
 - 1. A narrative description of the activities that will be accomplished in each phase of the commissioning, including the personnel intended to accomplish each of the activities.
 - 2. A listing of the specific equipment, appliances, or systems to be tested, and a description of the tests to be performed.
 - 3. Functions to be tested including, but not limited to, calibrations and economizer controls.
 - 4. Conditions under which each test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
 - 5. Measurable criteria for performance.
- G. Prepare and provide project-specific pre-functional construction checklists and functional test procedures.
- H. Prepare and update the Issues Log as contractors notify the Division 23 Contractor of corrections or updates.
- I. Commission systems identified within this Section. The commissioning scope is identified in Part 3 of this Section.
- J. Observe the installation of the systems. Identify any items of non-compliance with the requirements of the Contract Documents.
- K. Perform functional tests in all operating modes with the cooperation of the Division 23 Contractor, representatives of the ATC system sub-contractor, and equipment manufacturer representatives.
- L. Verify that automatic control devices are functioning properly and that all of the control sequences of operation are met.
- M. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning reports.

1.8 ACCEPTABLE COMMISSIONING AGENTS

- A. Subject to compliance with requirements, engage one of the an independent Commissioning Agents to perform the work of this Section subject to approval of Engineer and Owner.
- B. The Division 23 Contractor may request the use of any firm, however this request shall occur no later than 10 days prior to the bid due date. The Division 23 Contractor request shall include qualifications of the individuals who are proposed to perform the work of this Section who are employed with a Commissioning firm. The qualifications shall include resumes of the commissioning technicians, a list of projects completed for each technician within the last 12 months, and no less than three (3) client references with contact information relevant to projects completed within the last 12 months for each technician. Do not submit 'generic' firm resumes or resumes of firm principals unless those individuals are proposed to do the actual field commissioning work on site for this Project. The decision regarding the acceptability of the proposed agent will be made by the Owner.

1.9 ACTION SUBMITTAL

- A. Commissioning Agent Qualifications: Verification of experience and capability of the CxA. This submittal is not required for Agents specifically listed above. The purpose of this submittal is to establish, in a proactive manner, that the CxA proposed by the Division 23 Contractor to perform the work of this Section is qualified. The Contractor's failure to obtain approval for this submittal prevents the Contractor from utilizing the proposed service provider. Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the CxA and this Project's commissioning team members meet the qualifications specified in the "Quality Assurance" Article below. Also submit the following:
 - 1. Resumes of the Cx technicians anticipated to work on this project.
 - a. Note: Do not submit 'generic' firm resumes or resumes of firm principals unless those individuals are proposed to do the actual Cx work on site for this project.
 - 2. A list of projects completed for each technician within the last 12 months. Include no less than three (3) client references with contact information relevant to projects completed within the last 12 months for each technician. The same project may be used more than once if multiple technicians worked on the project.
 - 3. A list of any projects completed for this same Owner within the last 3 years, if any, along with the technicians who worked on those projects, and the Owner's contact information.

1.10 INFORMATIONAL SUBMITTALS

- A. Test Reports:
 - 1. Pre-Functional Test Reports: Prior to startup of equipment or a system, submit signed, completed construction checklists completed by the Division 23 Contractor.
 - 2. Commissioning Issues Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.

3. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
 4. Functional Test Reports for each system and equipment commissioned.
- B. Manufacturers Startup and Checkout Procedures: Submitted by the Division 23 Contractor for all equipment specified in this Section to be commissioned.
- C. Preliminary Commissioning Report.
- D. Final Commissioning Report.

1.11 QUALITY ASSURANCE

- A. CxA Qualifications: Engage a Commissioning Agent who is a current ASHRAE certified 'BCxP' - Building Commissioning Professional, OR is a currently Building Commissioning Association 'CCP' - Certified Commissioning Professional, OR who is a currently licensed Professional Engineer (PE) in the state where the Project is located.
1. The CxA shall have a minimum of two (2) years full time equivalent experience performing work of a similar nature.
 2. The CxA shall furnish evidence of licensure or certification upon request of the Architect / Engineer or the Owner, along with a resume detailing two (2) years' worth of relevant experience, and no less than five (5) Building Owner references relevant to commissioning projects no older than five (5) years.
 3. The Owner reserves the right to reject the CxA on the basis of insufficient qualifications. The Division 23 Contractor may obtain pre-approval of their proposed CxA sub-contractor by submitting qualifications no less than ten (10) days prior to the bid-due date.
 4. The CxA may utilize direct employees or staff who are employed by the same company as the CxA to assist in performing the commissioning work, however the CxA shall be present at the site when any commissioning activities are taking place.
 5. The CxA, as referred to above, shall be taken to mean the particular individual meeting the qualification requirements, not other employees of the same firm or company.
- B. Commissioning Standards: Except as modified by this Section or the provisions of other Sections, all commissioning work by the CxA, including the scope and level of detail of pre-functional and functional checklists and test procedures, shall comply with one of the following:
1. ANSI / ASHRAE / IES Std. 202-2018, "Commissioning Process for Buildings and Systems" and ASHRAE Guideline 1.1-2007, "HVAC&R Technical Requirements for the Commissioning Process"
 2. ANSI / SMACNA "HVAC Systems Commissioning Manual", 2nd edition (2013).
 3. The Building Commissioning Association's (BCxA's) "The Building Commissioning Handbook", 3rd edition (2017)
- C. The commissioning process shall be in full compliance with the requirements of the 2018 International Energy Conservation Code.

1.12 PROJECT CONDITIONS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire commissioning period. Cooperate with the Owner during Cx operations to minimize conflicts with the Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during Cx operations to minimize conflicts with Owner's operations.
- C. Partial Owner Occupancy: Owner will occupy areas of building outside of the immediate work area during the testing, adjusting, and balancing period. Cooperate with Owner during Cx operations to minimize conflicts with Owner's operations.
- D. Renovation Phasing: The Project is being performed in phases, with new / renovated HVAC systems being brought on-line at varying points in time during the project duration. The Owner will be retaining full use and occupancy of areas served by HVAC sub-systems not being renovated under the current phase. Near the end of each phase of equipment replacement / system modification, the Cx Agent shall perform commissioning on the portion of the system added and/or modified and/or affected by the work of that phase.
- E. New Construction Phasing: The Project is being constructed in phases, with new HVAC systems being brought on-line at varying points in time during the project duration. The Owner will be occupying areas of the building as they come on-line. Near the end of each phase of construction, the Cx Agent shall perform commissioning on the systems or portions of systems added or extended by the work of that phase.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division 23 Contractor for the equipment being tested. The Division 23 Contractor is responsible for all standard testing equipment for the HVAC system and controls system.
- B. Two-way radios for the cooperative use of all parties involved in the commissioning process shall be provided by the Division 23 Contractor.
- C. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Division 23 Contractor and left on site.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances indicated in the Specifications. If not otherwise noted, the following minimum requirements apply:

1. Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F.
2. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.
3. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 SYSTEMS TO BE COMMISSIONED

- A. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies (i.e. sampling approaches are not acceptable).
- B. Plumbing Systems: Service water heating systems, including the heaters, mixing valves, recirculation pumps, heater-mounted pumps, and all associated controls.
 1. Functional testing of service water heating systems shall not occur until the domestic water testing and balancing work has been completed.
- C. HVAC Systems:
 1. DDC System / Building Automation and Controls
 2. Refrigerant Monitoring System
 3. Variable Frequency Drives / Controllers
 4. Fans
 5. Rooftop Air Conditioning Units
 6. Make Up Air Units
 7. Air Handling Units
 8. Air Terminal Units
 9. Hot Water Duct Coils
 10. Terminal Heating Equipment (e.g. Radiant Panels, Fin Tube Radiators, Cabinet Heaters, Unit Heaters)
 11. Hot Water Boilers
 12. Hot Water Pumps
 13. Cooling Tower
 14. Condenser Water Pumps
 15. Condenser Water Chemical Treatment Systems
 16. Water Chillers
 17. Chilled Water Pumps
 18. Electric Heat Trace Systems
 19. Air Curtains

3.2 EXAMINATION AND VERIFICATION BY THE COMMISSIONING AGENT - GENERAL REQUIREMENTS

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper commissioning of systems and equipment.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- D. Examine system and equipment installations to verify that they are complete and that Manufacturer's start-up and Division 23 Contractor testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine system and equipment test reports produced by the Division 23 Contractor as specified in individual Specification Sections.
- F. Verify that systems have been air and water tested and balanced prior to beginning functional testing.
- G. Examine systems for functional deficiencies that cannot be corrected by commissioning or by adjusting and balancing.
- H. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions.
 - 4. Automatic modulating control valves are properly connected.
 - 5. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to design values.
- I. Report deficiencies discovered in the Issues Log.

3.3 EXECUTION OF PREFUNCTIONAL CHECKLISTS AND STARTUP

- A. The CxA shall develop the Prefunctional Testing Forms for each system that is to be commissioned.
 - 1. Prefunctional checklists cannot modify or conflict with the Contract Documents.

2. Prefunctional checklists are important to ensure that the equipment and systems are fully installed and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are permitted. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
 3. These checklists and tests shall be provided by the CxA to the trade responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form will have more than one trade responsible for its execution.
- B. Start-Up Plan: The Division 23 Contractor shall develop the full start-up plan by combining (or adding to) the CxA checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
1. The full start-up plan consists of:
 - a. The CxA pre-functional checklists.
 - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - c. The manufacturer's normally used field checkout sheets.
 2. The Division 23 Contractor shall submit the full startup plan to the CxA for review and approval. The CxA reviews the procedures and the format for documenting them, noting any procedures that need to be added.
- C. Prior to equipment or system startup, the Division 23 Contractor and associated vendors shall schedule startup and checkout with the CxA. The completion of the prefunctional checklists and startup and checkout shall be directed and executed by the Division 23 Contractor and/or equipment manufacturer's representative. When checking off prefunctional checklists, signatures may be required of other prime contractors or sub-contractors for verification of completion of their portion of the work.
- D. The Division 23 Contractor and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.
- E. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.4 DEFICIENCIES AND NON-CONFORMANCE DISCOVERED DURING PRE-FUNCTIONAL CHECKS AND STARTUP.

- A. The Division 23 Contractor shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the Division 23 Contractor within two days of test completion.
- B. The installing Division 23 Contractor or equipment suppliers / vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, shall notify the CxA as soon as outstanding items have been corrected, and shall resubmit an updated start-up report and a Statement of Correction on the original non-compliance report.
- C. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

3.5 FUNCTIONAL PERFORMANCE TESTING - GENERAL REQUIREMENTS

- A. Functional testing shall be conducted after prefunctional testing and startup has been satisfactorily completed. The control system shall be sufficiently tested and approved by the CxA before it is used for testing, adjusting, and balancing or to verify performance of other components or systems. The air balancing and water balancing shall be completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems shall be checked.
- B. Objectives and Scope: The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent, sequence of operations, and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
 - 1. Each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
 - 2. Tests shall also include the following:
 - a. Redundant or automatic back-up mode
 - b. Alarm reporting performance
 - c. Mode of operation upon a loss of normal power and restoration of normal power
 - d. Air economizer functions
- C. Development of Test Procedures: The CxA will develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. The Division 23 Contractor or equipment vendor who is responsible to execute a given test, shall provide assistance to the CxA in developing the procedures review (answering questions about equipment,

operation, sequences, etc.). The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

- D. The Division 23 Contractor shall review the proposed tests for feasibility, safety, and equipment and warranty protection.
- E. The CxA shall direct and document the tests.
- F. The Division 23 Contractor shall provide technicians, instrumentation, and tools to conduct the functional tests as directed by the CxA. The Division 23 Contractor shall operate the equipment and systems during tests. Other installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.6 FUNCTIONAL TEST METHODS

- A. Functional performance testing and verification may be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The CxA shall determine which method is most appropriate for tests that do not have a method specified.
 - 1. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
 - 2. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. (e.g. For the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response.) Before simulating conditions or overwriting values, sensors, and transducers, devices shall have been calibrated.
 - 3. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
 - 4. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
 - 5. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.

- B. Setup: Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Division 23 Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Division 23 Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
- C. Coordination and Scheduling: The Division 23 Contractor shall provide sufficient notice to the CxA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the Construction Manager, General Contractor, and Division 23 Contractor. The CxA shall perform, witness, and document the functional testing of all equipment and systems. The Division 23 Contractor shall be available when the tests are executed.

3.7 DEFICIENCIES AND NON-CONFORMANCE DISCOVERED DURING FUNCTIONAL TESTING

- A. If any deficiency in the installation of the work discovered during initial functional testing operations prevents complete, accurate, and uncompromised testing of the systems, the CxA shall report the deficiencies in writing. Any preliminary functional testing work done with the deficiency still present shall not be sufficient for acceptance, and re-testing shall be required after the deficiency has been fully corrected by the Division 23 Contractor.
- B. The CxA shall track and report commissioning compliance issues until resolution and retesting are successfully completed.
- C. If a test demonstration to the Architect / Engineer or Owner must be repeated due to failure caused by a Contractor's work or materials, that Contractor shall reimburse the Owner for billed costs for the participation in the repeated demonstration.

3.8 PROGRESS REPORTING

- A. Status Reports: As commissioning progresses, prepare bi-weekly (i.e. twice a month) reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being commissioned. Prepare a separate report for each system and piece of equipment.
- B. Preliminary Commissioning Report: The report shall be provided no later than 7 days prior to Substantial Completion. The preliminary report shall include the range of information specified below for the Final Cx Report, and the following additional items:
 1. Itemization of deficiencies found during testing that have not been corrected at the time of report preparation.
 2. Deferred tests that cannot be performed at the time of report preparation because of climatic conditions.
 3. Climatic conditions required for performance of the deferred tests.

3.9 FINAL COMMISSIONING REPORT

- A. Format: Paper copies, in three-ring binder, tabulated and divided into sections by commissioned systems and equipment.
- B. The Final Commissioning Report shall be issued no later than 90 days after the Owner's receipt of their Certificate of Occupancy.
- C. Contents: The report shall include the following:
 - 1. A certification sheet in front of binder signed and sealed by the certified CxA.
 - 2. General Report Data:
 - a. Title page.
 - b. Name and address of CxA firm.
 - c. Project name.
 - d. Project location.
 - e. Architect's name and address.
 - f. Engineer's name and address.
 - g. Division 23 Contractor's name and address.
 - h. Report date.
 - i. Signature of CxA who certifies the report.
 - j. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 3. Functional test procedures used during the commissioning process, including measurable criteria for test acceptance, provided herein for repeatability.
 - 4. Final functional test reports
 - 5. Pre-function test checklists
 - 6. Final Issues Log
 - 7. Disposition of deficiencies found during testing, including details of corrective measures used or proposed

3.10 OPPOSITE SEASON FUNCTIONAL PERFORMANCE TESTING

- A. Functional performance testing shall be performed for those systems and portions of the sequences of operation that could not be adequately tested during the primary phase of commissioning due to the climatic conditions. Test results and updated issues logs shall be issued by the CxA as addendums to the Final Cx Report. All functional testing shall be complete within one (1) year of Substantial Completion.
- B. The Division 23 Contractor and ATC sub-contractor shall be present upon request of the CxA.

3.11 ADDITIONAL COMMISSIONING INVESTIGATIONS AND TESTS

- A. After acceptance of the final commissioning report, and within one (1) year of Substantial Completion, provide up to 16 hours of on-site time to verify that the proper operation of systems are being maintained throughout, and to investigate and correct unusual conditions. This allowance may be required over as many as four (4) separate site visits. The additional on-site time shall be provided at the request of the Owner or Engineer.

END OF SECTION 230800

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 23 Section, 230993 - "Sequence of Operation for HVAC Controls" for sequences of operation and additional control system requirements.
- C. Other Division 23 Sections for factory mounted controls and communication interface gateways and DDC System Sub-Contractor led commissioning for equipment with factory controls packages.

1.2 SYSTEM DESCRIPTION

- A. The Direct Digital Control (DDC) System shall be entirely electronic utilizing microprocessor based direct digital temperature controllers and electric valve and damper actuators. System shall be complete in all respects including microprocessor, graphical user interface software, sensors, actuators, and other software in order to provide the functions described.
- B. The DDC system shall be a peer-to-peer networked, stand-alone, distributed control system that is an 'open system'.
 - 1. An 'open system' shall be defined as one that naturally facilitates and permits the Owner to engage the services of a future vendor different than that which provided this system under this Contract, to service, expand, and modify the system provided without requiring the services of, or future payment to, the controls vendor who initially provided the system.
 - 2. To ensure that an open system is provided, this Direct Digital Control System shall include, but not be limited to having, the following features:
 - a. Utilize a Tridium Niagara 4 software platform.
 - b. Utilize only commonplace forms of ANSI/ASHRAE Standard 135-2012 BACnet technology communication protocols as further specified herein, and without the use of any proprietary gateways or routers.
 - c. Utilize only BTL listed controllers as further specified herein.
 - d. Provide a perpetual software license for all software furnished to the Owner.
 - e. Provide native format copies of all software tools, configuration files, control programs, etc. to the Owner.
- C. Access to the control system, either locally in the building, or remotely, shall be accomplished through the following:

1. DDC system webserver, using standard web browsers, via the internet and/or local area network.
- D. The proposed system shall be backwards compatible so as to eliminate system obsolescence and provide seamless integration of future systems and software installed on future projects.
- E. The DDC system shall be UL864 listed for smoke control and life safety / fire alarm use.

1.3 SUMMARY

- A. Throughout this specification, any reference to "DDC Contractor or Subcontractor", "ATC Contractor or Subcontractor", "BMS Contractor", "BAS Contractor", "Control Contractor", "installer", "supplier", "Manufacturer" or "local field office" shall be interpreted as referring to the automatic temperature control system supplier/installer performing the work of this Section, and Section, 230993 - "Sequence of Operation for HVAC Controls".
- B. All labor, material, equipment and software not specifically referred to herein or on the Drawings, that are required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.
- C. The DDC Contractor shall be responsible for integrating factory-supplied HVAC unit controls (supplied by the unit manufacturers) into a unified system in order to provide flexibility for expansion, maintenance, and service of the system.
 1. It is the responsibility of the DDC Contractor to coordinate, during the bid period, with the Division 23 Contractors regarding factory supplied controls.
 2. All equipment furnished with controls that are furnished and installed by the manufacturer shall have BACnet MS/TP or BACnet IP communication capability from the equipment manufacturer unless coordinated otherwise between the DDC Contractor and the equipment supplier, with the approval of the Architect / Engineer.
 3. Coordinate and resolve incompatibility issues that arise between control products provided under this Section and those provided under other Sections or Divisions of the Contract Document Specifications.
 4. The DDC Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.
 5. Map all available points available from factory supplied control system interfaces.
- D. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).
- E. The system shall be provided completely by the DDC Contractor with the exception of any factory-supplied HVAC unit controls and any factory supplied dampers that are integral to equipment. Furthermore, items such as automatic control valves, separable wells, and field-applied automatic dampers, shall be furnished by the DDC Contractor to the Division 23 Contractor for installation. DDC Contractor shall select the proper location for each control valve, separable well, or damper to be installed by the Division 23 contractor, and shall supervise installation of same.

- F. After completion of the installation, the DDC Contractor shall completely adjust all control equipment provided under this contract, place the system in operation, subject to the engineer's approval, and instruct the operating personnel in the operation of the control system.
- G. The temperature control system supplier shall satisfactorily complete the entire control system so that it is functional and operating to the satisfaction of the Architect. Systems and their controls and their sequencing shall be demonstrated and operated to the satisfaction of the Architect. It is the intent of this specification that this entire system, with its complement of equipment and controls, operate properly in accordance with the design concept and functional intent.
- H. All product names and manufacturer names listed as acceptable products or manufacturers in this Section shall be taken to only be acceptable subject to meeting the project requirements (as defined by the Project Specifications, Sequences of Operation, and Drawings), and approval of a product submittal by the Architect / Engineer.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements, while all DDC-controlled HVAC systems are operating, and trend data (equivalent to up to 20% of the total system point count, with each trended point collected every 60 seconds) is being reported to the building automation database server:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds, and shall automatically refresh every 15 seconds.
 - 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
 - 4. Object Command: Reaction time of less than two (2) seconds between operator command of a binary or analog object and device reaction.
 - 5. Object Scan: Transmit change of state and change of analog values to control units or workstation within six (6) seconds.
 - 6. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations shall receive alarms within five (5) seconds of each other.
 - 7. Program Execution Frequency: Run capability of both custom and standard applications may be as often as five (5) seconds. Select execution times consistent with mechanical process under control.
 - 8. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at an adjustable frequency down to once per second. Select execution times consistent with mechanical process under control.
 - 9. Minimum Reporting Accuracy: Report values within the minimum tolerances as follows, unless a more demanding value is specified elsewhere:
 - a. Water Temperature: Plus or minus 0.5 deg F (0.25 deg C).
 - b. Water Flow: Plus or minus 3% of full scale.
 - c. Water Pressure, Absolute and Differential: Plus or minus 2% of full scale.
 - d. Space Temperature: Plus or minus 0.5 deg F (0.25 deg C).
 - e. Ducted Air Temperature: Plus or minus 0.5 deg F (0.25 deg C).
 - f. Outside Air Temperature: Plus or minus 1 deg F (0.5 deg C).

- g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
 - h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
 - i. Relative Humidity: Plus or minus 2% of full scale.
 - j. Airflow (Pressurized Spaces): Plus or minus 3% of full scale.
 - k. Airflow (Measuring Stations): Plus or minus 5% of reading.
 - l. Airflow (Terminal): Plus or minus 10% of full scale.
 - m. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
 - o. Carbon Monoxide: Plus or minus 5% of reading.
 - p. Carbon Dioxide: Plus or minus 50 ppm.
 - q. Electrical: Plus or minus 2% of reading.
10. Minimum Control Accuracy: Maintain measured variables within the minimum tolerances as follows, unless a more demanding value is specified elsewhere:
- a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
 - b. Water Flow: Plus or minus 5% of full scale.
 - c. Water Pressure, Absolute and Differential: Plus or minus 3% of full scale.
 - d. Space Temperature: Plus or minus 1.5 deg F (0.7 deg C).
 - e. Ducted Air Temperature: Plus or minus 2 deg F (1 deg C).
 - f. Relative Humidity: Plus or minus 4% of full scale.
 - g. Airflow (Pressurized Spaces): Plus or minus 5% of full scale.
 - h. Airflow (Measuring Stations): Plus or minus 7% of reading.
 - i. Airflow (Terminal): Plus or minus 15% of full scale.
 - j. Air Pressure (Space): Plus or minus 0.02-inch wg (5 Pa).
 - k. Air Pressure (Ducts): Plus or minus 0.2-inch wg (50 Pa).
 - l. Carbon Dioxide: Plus or minus 50 ppm.

1.5 ACTION SUBMITTALS

- A. Qualifications and Proposed System Summary Submittal: The purpose of this submittal is to establish, in a proactive manner, that the vendor proposed by the Division 23 Contractor to perform the work of this Section and related Sections is qualified and intends to deliver the system specified. Failure to obtain approval for this submittal prevents the Contractor from utilizing the proposed vendor. Submittal of detailed information characteristic of the "Primary Submittal" described below without an approved "Qualifications and Proposed System Summary" submittal shall result in rejection of the detailed submittal without review. Within 30 days of contract award / notice to proceed, the Contractor shall submit the following information:

- 1. Qualifications:
 - a. Company name, number of years in business, and any other name the company may have done business under in the last 10 years.
 - b. Location of the nearest full service office. "Full service" refers to an office staffed with applications engineers, software engineers, and field technicians, that maintains a parts inventory, and that has testing and diagnostic equipment to support the work.
 - c. Resumes of the staff proposed to manage and perform the work of this project.
 - d. Identification of those staff who are Niagara certified.

- e. Identification of factory-trained technicians directly employed by the proposed vendor, who live within 100 miles of the job site.
 - f. Identification of qualifying project experience, with a description of the work performed, the system installed, and a contact information for the Owner of those projects. Refer to the "Quality Assurance" article below in this Section for additional requirements relating to qualifications, qualifying experience, and number of past projects.
2. Proposed System Summary: Provide the following information for the system proposed to be used for this Project:
- a. Management level system software platform and details of the user interface software.
 - b. Basic network diagram.
 - c. Product data sheets for building controllers and Tier 2 / field level controllers. Indicate where / how these controllers can be purchased.
 - d. Communication protocol at each level/ tier of the system.
 - e. Listing of all service tool software required to modify or extend the system, and how usable copies of this software can be obtained by the Owner, and at what cost.
 - f. Sample copy of the Niagara software license certificate(s).

B. Primary Submittal:

- 1. Shop drawings and product data of the entire DDC System shall be submitted and shall consist of no less than the following:
 - a. Product Data: A complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated. Include software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system.
 - 1) DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - b. Complete wiring and schematic diagrams showing each control point and field device. Schematic control diagrams shall also indicate points obtained from equipment factory packaged control devices. The depictions of these points shall appear alongside field-applied devices and points on the same diagram / schematic.
 - c. Terminal identification for all control wiring.
 - d. A complete point list of all points to be connected DDC System.
 - e. List of points obtained through the connection to equipment factory packaged controllers. This list shall appear alongside a points list of field-applied devices/points related to the equipment.
 - f. Proposed point naming and tagging conventions.

- g. A complete written Sequence of Operation. The sequence shall also incorporate and reflect the control sequence of factory packaged controls.
 - h. Schedule of dampers including size, leakage, and flow characteristics.
 - i. Schedule of valves including flow and leakage characteristics and shutoff ability.
 - j. Schedule of damper and valve actuators.
 - k. Schedule of airflow measuring stations. The airflow measuring station manufacturer's representative shall prepare this portion of the submittal by reviewing equipment and ductwork shop drawings to ensure that the proposed installations of the airflow measuring stations meet the requirements and recommendations of the station manufacturers for accuracy, including straight duct upstream and downstream of the station. Install airflow straighteners if required by the manufacturer to meet the specified accuracy given the installation constraints.
 - l. Schedule of flow measuring stations / meters. The flow meter selection, product application, and submittal process and requirements shall be as described above for airflow measuring stations.
- 2. Division 23 and 26 Contractors supplying products and systems as part of their packages shall provide catalog data sheets, wiring diagrams and point lists to the BAS Contractor for proper coordination of work. Such information shall be included in this primary ATC submittal.
 - 3. Submittal shall also include a trunk cable schematic diagram depicting Tier 1 (head end) controllers, Tier 2 (field level) controllers, control panel locations and a description of the communication type, media and protocol. Though the Division 23 and 26 contractors shall provide these diagrams for their portions of work, the BAS Contractor shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN).

C. Graphics Submittal:

- 1. This submittal shall occur after the primary submittal described above, but not less than 4 weeks prior to the planned date for installing graphics into the system in the field.
- 2. Include a copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 90% complete at this stage with the only remaining changes to be based on review comments from the A/E design team and/or Owner.
 - a. The graphics submitted shall be the actual graphics intended to be utilized on this project, and shall be completely job specific.
 - b. Generic or typical graphics are not acceptable, however a single typical graphic may be submitted for types of equipment where this project has multiple, identically controlled pieces of equipment (e.g. VAV boxes, fan coils, etc.).

D. Samples: For each color required, of each type of thermostat, or space sensor cover.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control / commissioning test reports.
 - 1. Phase I - General Performance Testing reports.
 - 2. Phase II - Operational Sequence Testing reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Maintenance instructions and lists of spare parts for each type of control device.
 - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 5. Calibration records and list of set points.
 - 6. A schedule of all manufacturer's extended warranties on component parts of the DDC system which come with such a warranty. The schedule shall list the start and end dates, the manufacturer's name, and the component or device name. Included with the schedule shall be copies of the manufacturer's warranty certificates.
- B. Software and Firmware Operational Documentation: Include the following:
 - 1. Software operating and upgrade manuals, including the DDC programming tool user manual.
 - 2. Program Software Backup: On a DVD, complete with data files.
 - 3. Device address list.
 - 4. Printout of as-built software application and graphic screens. Also include an electronic softcopy.
 - 5. Software licenses required by and installed for DDC workstations, control systems, and programming tools.
 - 6. Any additional items described in the article herein titled "Software License Agreement And Service Tools".
- C. Software Upgrade Kit and Upgrade Documentation: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- D. Complete 'As-Built' Documents: Provide electronically and in paper manual form. Electronic drawings shall be provided as AutoCAD™ compatible files (.dwg or .dxf) or as Visio files, as per the preference of the Owner, as well as PDF format. Three paper hard copies of the 'as-built' documents shall be provided in addition to the documents on flash drive, DVD, or CD. Division 23 and 26 contractors shall provide 'as-builts' for their portions of the control work. This contractor shall be responsible for 'as-builts' pertaining to overall DDC System architecture and network diagrams. All as built documents shall also be installed into the DDC NAC in a dedicated directory.

1. Contractor's 'as-built' documents shall include manufacturer's Protocol Implementation Conformance Statement (PICS) for operator's interface software and every controller model that is installed. Include BTL tested and certified information for DDC controllers such as Building Controllers (B-BC), and each standalone DDC control unit (SDCU) conforms to the BACnet device profile B-AAC. Application specific controllers shall conform to BACnet device profile B-ASC.

1.8 WARRANTY

- A. General Warranty: This warranty shall cover all costs for parts, labor, software, associated travel, and expenses for a period of one (1) year from the date of final acceptance by the Architect / Engineer and the Owner, and shall keep the control system adjusted throughout the first year.
 1. This warranty shall apply equally to both hardware and software, and all related end devices.
 2. Upon receipt of DDC system commissioning reports (both Phase I and Phase II testing), and when the system performance is deemed satisfactory by the Architect / Engineer and the Owner, the system parts will be accepted for beneficial use and the warranty period shall begin.
 3. Provide a quote, at the time of bidding, to extend the general warranty period to a second, full year of warranty and warranty maintenance specified below. Refer to the project bid form.
- B. Extended Warranty: The Owner shall be granted no less than five (5) years of software maintenance / updates, at no additional cost. This shall include technician labor, and applies to all software furnished, including, but not limited to, software from /for sub-vendors, building controllers, and building automation database servers.

1.9 WARRANTY MAINTENANCE

- A. At no cost to the Owner, during the warranty period, the Contractor shall provide maintenance services for software and hardware components as specified below:
 1. Qualifications: The contractor shall utilize factory-trained technicians located within 100 miles of the job site. Technicians shall be in direct employment of the DDC system sub-contractor.
 2. Maintenance services shall be provided for all devices and hardware specified in this Section. Service all equipment per the manufacturer's recommendations. All devices shall be calibrated within the last month of the warranty period.
 3. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the Owner to the Contractor.
 - a. Response to any request for service shall be provided within two (2) hours of the Owner's initial telephone request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician,

trained in the system to be serviced, shall be dispatched to the Owner's site within eight (8) hours of the Owner's initial telephone request for such services, as specified.

4. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the Owner to the Contractor.
 - a. Response to any request for service shall be provided within eight (8) working hours (contractor specified 40 hr. per week normal working period) of the Owner's initial telephone request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the Owner's site within three (3) working days of the Owner's initial telephone request for such services, as specified.
5. Technical Support: Contractor shall provide remote technical support throughout the warrantee period.
6. Preventive maintenance shall be provided throughout the warrantee period in accordance with the hardware component manufacturer's requirements.
7. The Owner shall grant to the DDC System Contractor, reasonable access to the DDC System during the warranty period. The Owner shall allow the contractor to access the DDC System from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

B. The Owner shall be granted no less than five (5) years of software maintenance, at no additional cost.

1.10 DEFINITIONS

A. Some of the acronyms used in this specification are as follows:

| | |
|------|---|
| DDC | Direct Digital Control System |
| NAC | Network Area Controller |
| IBC | Interoperable BACnet Controller |
| GUI | Graphical User Interface |
| WBI | Web Browser Interface |
| POT | Portable Operator's Terminal |
| PMI | Power Measurement Interface |
| LAN | Local Area Network |
| AHJ | Authority Having Jurisdiction |
| WAN | Wide Area Network |
| PICS | Product Interoperability Compliance Statement |
| I/O | Input / Output |

| | |
|-------------|--|
| MS/TP | Master Slave/Token Passing |
| PC | Personal Computer |
| PID | Proportional (plus) Integral (plus) Derivative |
| RTD | Resistance Temperature Detector |
| OWS | Operator's WorkStation |
| AAC | Advanced Application Controller |
| ASC | Application Specific Controller |
| HMI | Human-Machine Interface |
| Workstation | Generically refers to the HMI and associated software and graphics |
| HOA | Hand-Off-Auto (switch) |
| SPST | Single Pole, Single Throw |
| SPDT | Single Pole, Double Throw |
| DPDT | Double Pole, Double Throw |
| DPST | Double Pole, Single Throw |
| BC | Building Controller |
| BO | Binary Output (w/ respect to the DDC system) |
| BI | Binary Input |
| AO | Analog Output |
| AI | Analog Input |
| DO | Digital Output |
| DI | Digital Input |
| IP | Internet Protocol |
| NIST | National Institute of Standards and Technology |
| E/P | Electric / Pneumatic Transducer |
| I/P | Current to Pneumatic |

B. Miscellaneous Definitions:

1. Automation level network (aka. 'head end' or 'host level'): The portion of the system generally consisting of the user interface(s), workstation hardware (if present), web server (if present), building / network level controllers, database server, network media converters, routers, and switches.
2. Field Level Network: The portion of the system generally consisting of advanced application controllers, application specific controllers, and controllers that are factory furnished as part of packaged equipment.

1.11 SCOPE

- A. The scope of work for the temperature controls system includes, but is not limited to, the following:
1. Provide a complete Direct Digital Control System for all Division 23 systems and equipment, unless otherwise indicated.

2. Provide raceways and conduits as required by the installation. Provide wiring, cable, conduit, hangers, fittings, and couplings. Make final connections to control devices.
3. Provide water control valves and automatic control air dampers, complete with electric actuators.
4. Provide integration of factory mounted DDC controls furnished under other Sections as described herein.
5. Provide controls in pre-wired apparatus control panels. Internal components shall be fully pre-wired so that only external connections need to be made to these panels. Control panels shall be provided complete with controllers, relays, transformers, terminal strips, wire-way, convenience outlet, and fuses.
6. Furnish complete sets of submittals and installation drawings as described herein.
7. Provide complete start-up, commissioning and testing, and training services.
8. Provide floor plans and mechanical system graphics on the building automation database server.
9. Provide a complete set of DDC operating manuals, programming manuals, maintenance manuals and back up DVD/Software used to set up, and program the DDC system.
10. Provide Owner's Manual, complete operating instructions and spare parts lists.
11. Coordinate DDC work with the work of the other Contractors involved in this project and the Commissioning Agent.
12. Review the approved and finalized HVAC equipment submittals for control requirements of that equipment. Look for requirements related to minimum run times, temperature limits, minimum flow rates, and similar parameters. Modify control programming to implement the equipment manufacturer's recommendations and requirements. Direct questions regarding conflicts between manufacturer's requirements and the sequences of operation to the Architect / Engineer.
13. Review the Division 23 Contractor's preliminary ductwork and piping shop drawings and identify the required locations of all duct and piping system mounted input and output control devices. Identify conflicts for resolution prior to submission of the shop drawings.

B. Automatic Temperature Control System Coordination:

1. Factory Controls: The Division 23 Contractor (HVAC system installer) providing HVAC equipment shall coordinate with all of their equipment suppliers providing factory controllers to furnish the following to the DDC Contractor:
 - a. A BACnet Conformance statement applicable to the controller or gateway BACnet device profile classification (i.e. B-ASC - Application Specific Controller; B-AAC - Advanced Application Controller; B-BC - BACnet Building Controller, etc.).
 - b. Documentation identifying all addressable points available from the controller or gateway including device ID, detailed point descriptions and addresses.
2. Control Signal and Control Power Wiring: Power wiring ATC system panels and electric motor operated dampers will be provided under Division 26 only where such work is shown on the Electrical Drawings. Where such required work is not indicated on the Electrical Drawings, power wiring for control systems shall be provided under Division 23 by the ATC sub-contractor.
 - a. Control signal and interlock wiring (regardless of voltage) for HVAC control systems and equipment shall be provided under Division 23 by the ATC sub-contractor.

- b. The ATC sub-contractor shall be responsible for furnishing and installing the thermostats, aquastats, etc. and similar line voltage devices for final wiring connections under Division 26, as applicable. Coordinate all work with the work of Division 26.
 - c. The Division 26 Contractor will be providing 120V, 20A circuits terminated in junction boxes throughout the building for the ATC system provider / sub-contractor's use in providing power to controllers and control devices requiring power, including VAV boxes and similar terminal control equipment. Power sources to some specific ATC equipment may also be indicated on the Electrical drawings. Control power wiring work from these Division 26-provided power sources to the control system controllers and other devices, including any required control transformers, are the responsibility of the ATC system sub-contractor.
 - d. Provide disconnect (toggle) switches at all 120V power supply connections to control devices / equipment / controllers. This includes, but is not limited to, electric actuators, transmitters, and control panels.
 - e. All electrical work provided under Division 23 shall conform to the National Electric Code and applicable Division 26 specifications.
3. Smoke Detectors: Duct type smoke detectors for HVAC equipment will be furnished under Division 26 or 28 and shall be installed under Division 23 by the HVAC system installer to conform to the requirements of the building code. Wiring from contacts on the smoke detectors or associated zone area modules to the motor controls of HVAC equipment shall be provided by the ATC Subcontractor to shut down the associated air handling equipment upon the detection of smoke in accordance with the requirements of the building code. Power wiring and interface wiring from the duct type smoke detectors to the building fire alarm panel will be provided under Division 26 or 28.
 4. Thermowells and Flow Meters: Separable thermowells for pipe mounted temperature sensors required for ATC operation, and flow meters, shall be furnished by the ATC Subcontractor and installed in pipelines by the HVAC system installer at locations required by the ATC Subcontractor.
 5. Pipeline pressure monitoring piping taps shall be provided by the HVAC system installer at locations required by the ATC Subcontractor.
 6. Control Valves: Automatic temperature control valves for HVAC equipment shall be furnished by the ATC Subcontractor and installed by the HVAC system installer.
 7. Airflow Measuring Stations: Stations, whether duct, plenum, or equipment mounted, shall be furnished by the ATC Subcontractor and installed by the HVAC system installer unless clearly specified to be part of the equipment package. For ATC sub-contractor supplied stations, the ATC sub-contractor shall be present at the time the stations are mounted to verify proper installation for accuracy and shall approve the installation.
 8. Motor Operated Dampers: Field-applied motor operated dampers shall be furnished by the ATC Subcontractor as per this Section, and installed in ductwork and at intake and discharge air louvers and ventilators under Division 23 by the HVAC systems installer.
 - a. Air handling units and similar equipment may be factory furnished with dampers where indicated in the various other Division 23 equipment specification Sections.
 - b. Unless specified otherwise in the various Division 23 equipment specification Sections, damper operators shall be furnished and installed by the ATC Subcontractor.
 - c. The ATC Subcontractor shall supervise the installation of dampers furnished by them to the Division 23 HVAC systems installer for installation. The ATC

Subcontractor shall direct the Division 23 HVAC systems installer to provide blank off plates when the demands of the control application requires dampers smaller than duct size in order to provide for sufficiently linearization for control stability.

9. The Division 23 Contractor / HVAC System installer shall perform work specified elsewhere in this Section, and the following:
 - a. Provide pressure sensing taps required in piping complete with isolating petcocks.
 - b. Provide various HVAC equipment items complete with self-contained controls as described in other portions of the Specification.
 - c. Provide "approved" HVAC equipment submittals, including wiring diagrams, to the DDC Contractor for HVAC equipment provided under other Division 23 Sections.
 - d. Verify that the dampers are correctly installed so that they operate freely and close tightly. Provide blank off plates when directly by the ATC Subcontractor to reduce the functional size of control dampers to that which is smaller than the duct size.
 - e. All cutting and patching necessary for the installation/relocation/demolition of any existing automatic temperature controls system shall be performed by the HVAC systems installer.
 - f. Depict the locations, as coordinated with the ATC Subcontractor, of all ductwork and piping system mounted control devices, on the respective ductwork and piping shop drawings, and coordination drawings.

1.12 QUALITY ASSURANCE

- A. System Provider / Sub-Contractor Qualifications: Experienced installers, system integrators, programmers, and controls commissioning technicians who are direct employees of a field office of the specified controls manufacturer or are direct employees of an independent controls contractor that is factory authorized representative of the system proposed.
 1. The specific ATC system vendor's office and associated staff being proposed to do the work of this Section shall have:
 - a. Been continuously in business for no less than seven (7) years. Changes in the name of the business due to a change in ownership with no changes in staff other than ownership partners during the seven (7) year period is acceptable.
 - b. A full service office within 200 miles of the project site. "Full service" refers to an office staffed with applications engineers, software engineers, and field technicians, that maintains a parts inventory, and that has testing and diagnostic equipment to support the work.
 - c. Previously completed a minimum of three (3), fully installed, web-based, native BACnet systems similar to the system required for this project, that include a Tridium Niagara platform. The projects shall have been new system installations (not merely extensions or integrations of existing Tridium based systems) have been completed within the last four (4) years, but no more recently than 6 months. These projects shall have been installed by the bidding DDC sub-contractors' local office proposed to do the work of this project.
 - d. In their direct employment no less than two (2) technicians who have passed the Niagara N4 Certification Class who shall perform programming and installation of

the operator interface for this project. Evidence of these certifications shall be submitted to the Architect / Engineer upon request.

- e. In their direct employment no less than one (1) factory-trained technician qualified to service and maintain the system who lives within 100 miles of the job site.
2. The ATC system sub-contractor's project manager for this Project shall have no less than five (5) years of experience as a project manager, and no less than ten (10) years of total experience. All qualifying experience shall be in performing work similar to that described in this Section.
 3. Programmer Experience: Personnel developing control programs for this project shall be experienced with the control requirements of systems and equipment that are present on this project, have no less than five (5) years' experience in the building automation industry, and have completed no less than five (5) similar projects within the last two (2) years. It is required for the BAS Contractor to utilize different staff for development of different programs for the various equipment and systems included in this project should no single person in their employment have past experience in all equipment and systems included in this project.
- B. Control Product Manufacturer Qualifications: A company experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
1. The manufacturer shall offer software tool and development training to the public on a regular, ongoing basis.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. The DDC system and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.
- E. BACnet: The system shall comply with the native BACnet architecture **[and web browser access]** described in this specification. All Tier 1 and 2 controllers shall be approved by BACnet Testing Laboratories (BTL Listed).
- F. Code Compliance: All HVAC controls shall be programmed in order to meet all requirements articulated in ASHRAE 90.1- 2016 and the 2018 International Energy Conservation Code.
- G. ASHRAE Guideline 36: Sequences of operation and alarm management methods shall comply with the latest version of the guideline and all current addendums to the greatest extent possible. Identify any discrepancies between the sequences of operation included with these contract documents and the Guideline. Resolve discrepancies by requesting clarification from the Architect / Engineer.
- H. Engineering Review Meeting: After the Engineer has reviewed and returned the first submission of the Primary Submittal, an in-person meeting shall be held between the Engineer and the DDC system provider on a mutually agreeable day and time to review the comments and clarify any project requirements. The DDC system provider shall allocate no less than four (4) hours of

meeting time plus travel time and expenses. The meeting will be held at the HF Lenz Co. office in Johnstown PA.

1. It is the responsibility of the DDC system provider to contact the Engineer and propose days and times for the meeting after review of the Engineer's comments on the Primary Submittal.
- I. Point Naming and Tagging Conventions: All point text naming conventions shall be consistent in their use and application throughout the controls system. Point tagging shall be implemented, and shall utilize formats created under Project Haystack (<https://project-haystack.org/>) where applicable. The DDC system provider may develop their own conventions for tagging points and equipment types not yet covered under Project Haystack, however they shall be as consistent with Project Haystack as possible. Submit proposed point naming and tagging arrangements for approval prior to data entry.

1.13 FACTORY MOUNTED EQUIPMENT CONTROLS

A. DDC System Provider / Sub-Contractors Scope and Responsibilities:

1. Provide integration of the factory supplied controls into the Building DDC system. Factory supplied control points shall be programmed into the operator's interface, system applications and graphics software and operate seamlessly with the Building DDC system.
2. Coordinate and resolve incompatibility issues that arise between control products provided under this Section and those provided under other Sections or Divisions of the contract document specifications.
3. Communication Gateway Connections: Extend the appropriate / required portion of the DDC system network and connect to all packaged equipment controls, air and water flow meters, and other devices provided with communications gateways.
 - a. DDC system graphics shall initially incorporate all 'communication' points available through integration gateways provided with packaged equipment controls, air and water flow meters, and other devices provided with such communications gateways.
 - b. Within the warranty period, remove any points obtained through the gateway from the workstation graphics that the Owner desires to be removed.

B. Division 23 Contractor's Scope and Responsibilities:

1. The Division 23 Contractor shall ensure that the equipment manufacturer's representative is on-site during the DDC system commissioning process to ensure full integration of factory controls with the DDC System.
2. The Division 23 Contractor shall ensure that the manufacturer's representatives have made all project-specific adjustments and settings during equipment start-up to the factory controllers prior to the joint field-commissioning efforts.
3. All equipment furnished with controls that are furnished and installed by the manufacturer shall have BACnet MS/TP or BACnet IP communication capability from the equipment manufacturer.
 - a. Modbus TCP/IP is also acceptable, but only if BACnet MS/TP or BACnet IP is not offered by the equipment manufacturer, and the use of Modbus TCP/IP is fully

coordinated between the ATC system supplier and the equipment supplier, and is approved by the Architect / Engineer and the DDC system sub-contractor.

- b. The Division 23 Contractor's equipment supplier shall provide to the DDC system sub-contractor all documentation required for the mapping in of points obtained through communication gateway into the DDC system.
- C. Representatives from each manufacturer providing factory mounted controls and the DDC subcontractor shall cooperate in the integration of the individual systems operation prior to bid and during field installation and commissioning / functional testing.

1.14 SOFTWARE LICENSE AGREEMENT AND SERVICE TOOLS

- A. It is the Owners expressed goal to implement an open system that will allow products from a single supplier to be seamlessly integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system.
- B. The DDC sub-contractor / system provider shall provide to the Owner a perpetual software and firmware licensing agreement as a condition of this Contract. When signed by the Owner, it shall grant use of all programs and application software to Owner.
- C. The Owner shall take ownership of all proprietary material generated or used in the execution of this project as a requirement of this Contract.
 - 1. The Owner shall be the named perpetual license holder of all software associated with any and all incremental work on the project(s), including ALL configuration and service software tools, hardware, firmware, or documentation that was used in the development, programming, or commissioning of the system for this project.
 - 2. In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, programming tools, and application-level software developed for or used on the project. This shall include all custom, job-specific software code, network management tools, images, record drawings, and documentation for all configuration and programming that is generated for this project and/or configured for use with the Tridium Niagara platform, NAC(s), DDC System Building Automation Server (if provided), and any related LAN / WAN / Intranet and Internet connected routers and devices.
 - a. Materials shall be provided in native, virtual formats.
 - b. Copies shall be furnished on the network area controller as well as on separate physical media (DVD or flash drive).
 - c. All control devices furnished by this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of the project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable.
 - 3. The Niagara framework supplied for this project shall use an open access licensing procedure, so that the Owner will not need to authorize changes to the license to enable another Niagara integrator to gain full access to the system. Any admin-level IDs or passwords used by the DDC System Supplier needed for access to any system component or software program shall be provided to the Owner.

- a. All Niagara instances regardless of brand ID shall contain an open Niagara Capability Statement where all attributes are "*" for open. A locked NiCS (Niagara Compatibility Statement) will not be acceptable.
 - b. The Owner shall receive all administrator level passwords for engineering toolset at the first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the system.
4. Licenses shall not rely on a physical license key, dongle, or similar device.
 5. Be advised that the Owner will be obtaining the services of a separate control vendor, prior to final payment, to independently verify that all required configuration, programming, and service tools have been provided with the information and materials turned over the Owner at the conclusion of the project. Verification of an open license will also be performed.
 6. Provide a copy of the license certificate to the Owner and Architect / Engineer.
 7. Provide no less than three (3) of each type of proprietary hardware required to access the building controllers, if any (e.g. network adapters).
 8. Provide the paraphrase for each server and building controller to permit un-encryption of the database.
- D. The Owner shall be granted no less than five (5) years of software maintenance ./ updates, at no additional cost.

1.15 SYSTEM SOFTWARE - GENERAL REQUIREMENTS

- A. **Functionality and Completeness:** The Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. The Contractor shall include all software and programming not specifically itemized in these Specifications that is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.
- B. **Configuration:** The software shall support the system as a distributed processing network configuration.
- C. **Offsite Software Retainage:** Contractor shall be required to retain backup copies of custom software drivers and documentation of same for no less than ten (10) years with free access to the Owner for the same period. If the backup is not available within the specified time frame, Contractor shall recreate the custom software at no charge to the Owner.
- D. **Site Specific Application Programming:** Provide all database creation and site-specific, custom application control programming as required by these specifications, national and local standards, and for a fully functioning system. The BAS Contractor shall provide all initial site-specific application programming and thoroughly document programming. The programming shall meet the functional intent of the sequences of operation included in the contract documents. It is not acceptable for the BAS Contractor to merely provide typical or 'canned' software programs without thorough comparison to the contract document sequences of operation, and resulting modification as required. While the BAS Contractor is encouraged to utilize control programming that has been thoroughly tested and successfully implemented on past projects, where the control applications are very similar to this project, the BAS Contractor is still obligated to make project

specific modifications as required, and to identify discrepancies between the Contractor's proposed sequence and those in the contract documents. Similarly, the BAS Contractor shall evaluate the suitability of the contract document sequences of operation for implementation on this project. It is the BAS Contractor's responsibility to request clarification on sequence issues and questions that require such clarification, and to request approval for deviations from the contract document sequences of operation. All site specific programming shall be fully documented and submitted for review and approval, both prior to downloading into the panel, at the completion of functional performance testing, and at the end of the warranty period.

1.16 BIDDING

- A. The DDC system shall be provided by one of the following controls system suppliers:
 - 1. Distech Controls, as provided by Deckman Control Systems / Trinity Automated Solutions of Bridgeville PA
 - 2. Johnson Controls Inc., as provided by the Johnson Controls Inc. factory office in Youngstown OH or OZ Enterprises Inc. of Pittsburgh PA
 - 3. Siemens, as provided by the Siemens factory office in Bridgeville PA.
- B. All bidders shall be a recognized factory branch of a national control system manufacturer listed, or a factory-authorized representative or installer, or as explicitly specified above.
- C. Subject to compliance with requirements, third party control integrators who are factory licensed or approved installers of control equipment from one of the above listed control manufacturers are also acceptable. Furthermore, the above listing of control manufacturers who also offer non-Niagara and proprietary control systems in no way permits the use of those proprietary systems. In all cases, an open, Niagara-based system shall be provided as specified in this Section.

1.17 GENERAL SYSTEM REQUIREMENTS

- A. Refer to the Article titled "General Sequence of Operation Requirements" in Division 23 Section "Sequence of Operation for HVAC Controls" for additional, general system requirements.
- B. Scope: All control functions described in the sequences of operation shall be performed by the DDC system unless explicitly indicated otherwise. All work described shall be provided by the ATC system supplier/sub-contractor under the automatic temperature controls specification Sections unless explicitly indicated otherwise.
 - 1. In addition to meeting the requirements of the specifications, the DDC system sub-contractor is required to provide a particular control point if that control point is indicated in any one of the three possible control work representations that are part of these contract drawings. These three representations are the entirety of the HVAC drawings, the control sequences of operation, and the control diagrams on the HVAC drawings (when a diagram has been prepared for a given system or type of equipment). The omission of a particular control point from one or more of these three representations shall not be construed to mean this particular control point is not required if it is indicated in one of these representations. Inclusion of the point in any one of the representations obligates the Contractor to provide the point as part of the complete and functional control system.

C. Control Loops:

1. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup.
2. When a control loop is enabled or re-enabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a neutral value. The control loop in neutral shall correspond to a condition that applies the minimum control effect, i.e., valves/dampers closed, VFDs at minimum speed, etc.
3. The term “control loop” or “loop” is used generically for all control loops. These shall typically be PID loops, but proportional plus integral plus derivative gains are not required on all loops. Unless specifically indicated otherwise, the following guidelines shall be followed:
 - a. Use proportional only (P-only) loops for limiting loops (such as zone CO2 control loops, etc.).
 - b. Do not use the derivative (D) term on any loops unless field tuning is not possible without it.
4. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change, with a default of 25% per minute.

D. System Graphics: For each system or each piece of controlled equipment, display all points indicated in the points list or described in the sequences of operation or indicated in a control diagram on the Drawings (when applicable), as well as all operating modes, setpoints, high limit settings, time out periods, run times, temperature and pressure reset schedules, and active alarm conditions. Graphics of equipment and systems shall reflect the 'as-built' condition (i.e. do not use generic graphics). Locate all instruments and control objects as actually installed in the completed building. The graphics shall be no less detailed than the control diagram on the Drawings (where a diagram has been prepared for given system or type of equipment).

1. Hardwired Points: System graphics shall display all system points associated with physical / hard-wired input and output devices (e.g. temperature and pressure sensors, safety switches, valves, dampers, points to VFDs and magnetic motor starters, etc.)
2. Gateway Interfaces: System graphics shall incorporate all 'communication' points available through integration gateways provided with packaged equipment controls, air and water flow meters, and other devices provided with such communications gateways. Extend the appropriate / required portion of the DDC system network and connect to all such gateways. All gateway communication points shall be displayed on the system graphics on a separate page, linked from the main system graphic that shows all hard wired points. Communication points selected by the Architect / Engineer or the Owner shall also be displayed on the main system graphic.
3. Additional Specific Requirements:
 - a. Dampers and Valves: Clearly identify the commanded position of each actuator position as % open or % closed. Actuator feedback shall be shown on the graphic, included the status of related end switches.
 - b. Air Handling Units and Similar Systems:
 - 1) Display the current outdoor temperature and humidity conditions.

- 2) Clearly identify and provide navigation links to the graphics of all equipment or systems serving utilities to the air system.
 - 3) Display the current value and current control setpoint of all utilities served to the air system. Use the closest upstream sensor if a local sensor is not in the scope of work.
 - 4) Display the current operating mode of the air system. (e.g. Heating, Cooling, Warm-up, Economizer, etc.)
 - 5) Show all process variables and setpoints related to the discharge of the air system (pressures, flow rates, temperatures, humidity, dewpoint, etc.)
 - 6) Display current CO2 values and control setpoints, as applicable.
- E. Adjustable Values: All setpoints, thresholds, differentials, time delays, reset schedules, etc. indicated in the sequences of operation are initial recommendations only and shall be adjustable by the building operator at the DDC workstations or web browser via system graphics without re-programming (i.e. no alteration of system program code shall be required), assuming the user has the required access level.
1. All adjustable values shall be determined and/or verified during the DDC system commissioning process performed by the DDC system sub-contractor.
 2. Software points shall be used for all such adjustable values. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.
- F. VFD Points: Control points for variable frequency drives (VFDs) shall generally be obtained via communications between the VFD and the DDC system, however start / stop commands, speed command, drive run status, and alarm status points shall be hardwired. Coordinate with the VFD supplier the communications network card required to be furnished with the VFD. Unless additional points are indicated in the sequence of operation, or detail on the Drawings, provide the following minimum points through communications:
1. AI - Speed Reference / Feedback
 2. AI - Drive KW
 3. Run Time Totalization (hrs.)
 4. Drive Fault and Warning Details / Messaging
 5. AI - DC Bus Voltage
- G. Motor Controls:
1. Wire DDC system contacts for start/stop control over 3-phase motors to the magnetic motor starters provided by Division 26. Refer to the Electrical Drawings for locations of magnetic motor starters.
 2. The DDC system supplier shall provide line voltage control relays for automatic on-off control of single-phase motors. Locate relays near to the associated motor, and coordinate power wiring with the Division 26 Contractor. The DDC system supplier shall make power and control wiring terminations at the relay in accordance with applicable Division 26 provisions.
 3. Electrically Commutated (EC) Motors: EC motors serving fans and pumps indicated in the sequence of operation to have on-off and/or speed control shall receive an external binary and/or analog signal for this purpose. Note that for many EC motors, a zero (0) - VDC or -mA analog speed control signal is used to automatically de-energize the motor. Coordinate signal type requirements with the equipment supplier.

- H. Communication Gateway Connections: Extend the appropriate / required portion of the DDC system network and connect to all packaged equipment controls, air and water flow meters, and other devices provided with communications gateways.
- I. Factory Control Packages: Where equipment is specified in Division 23 with a factory control package, the DDC system sub-contractor shall be responsible for powering the unit controls (if not powered from the equipment's power connection), mapping points into the DDC system workstation when specified with a communication gateway, making control setting adjustments for proper operation with the assistance of the equipment factory's representative, commissioning and functionally testing the factory controls, and installing and wiring any field mounted control devices shipped loose and/or not factory wired.
- J. Units: All temperatures indicated in the sequences are in degrees Fahrenheit (deg. F.). Units of pressure are in inches water gauge (in. w.g.)
- K. Manual Overrides: The DDC system operator shall have the ability to override the speed, position, or operational status of all fans, dampers, pumps, and control valves via override command at the operator's workstation, including at the graphics, the I/O points list, and control logic pages. Any points manually commanded by an operator shall be clearly labeled and shall be reflected at all locations where manual commands can be executed. Values on the graphics shall also reflect any operator manual commands.
 - 1. Exceptions: Systems and equipment that perform a safety function shall not be capable of being overridden off or into a mode or position that would reduce the safety of the building. This includes, but is not limited to, lab exhaust fans, grease hood exhaust fans, refrigerant exhaust fans, smoke exhaust fans, stairway or elevator shaft pressurization, fans, and fans dedicated to ventilating fire pump rooms and fire command rooms.
- L. Trends: All inputs, outputs, and calculated points of the DDC system shall be capable of being trended. The DDC system provider shall establish trends for any points the Owner deems necessary. Trends shall be initially set for a sampling rate of once every 5 minutes for each point or as required by the Owner. Trends shall be maintained for a minimum of seven days for all terminal equipment unless required otherwise by the Owner. Viewing of trend graphs shall be available at the DDC via the web browser. DDC controllers, panels and workstations shall be selected with adequate memory and storage capacity. The workstation shall issue an alarm and provide the user opportunity to save trend data to files prior to erasure of that data. Auto-save features shall be incorporated into the system to retain user-selected trend data without requiring continual user input.
- M. Unless explicitly specified otherwise elsewhere, all modulating dampers and valves shall be proportioning. The use of tristate outputs (two coordinated digital outputs) for floating control of is not permitted.
- N. Damper and Valve Fail Positions: Unless explicitly specified otherwise elsewhere, all damper and valve actuators shall have spring return mechanisms (except where explicitly noted otherwise, and for 8" valves and larger, which do not require spring return). Unless explicitly indicated otherwise in the sequence of operation or on the Drawings, dampers and valves shall be configured for the following spring return fail positions.
 - 1. Outdoor air damper - Fail closed

2. Relief air damper - Fail closed
 3. Return air damper - Fail open
 4. Equipment automatic isolation valves - Fail open
- O. End Switches: End switches, where required by the sequences of operation, shall be a device that verifies the physical position of the damper. The use of auxiliary contacts on the actuator to indicate position is not acceptable. End switches shall be used to provide a "digital (binary) input" to the DDC system.
1. In addition to those indicated in the Sequences of Operation, provide an end switch to confirm the fully closed status of all dampers at intake and relief /exhaust louvers, gravity ventilators, and similar locations where the damper maintains continuity of the exterior building envelope when the associated air handling apparatus is de-energized or the damper is commanded closed. The DDC system shall issue an alarm when the damper fails to fully close.
- P. Damper and Valve Positions: Knowledge of damper and valve position are required for implementation of trim-and-respond type reset control loops, such as variable speed pump and fan remove differential pressure setpoint reset control. The following are acceptable methods for determining valve and damper positions:
1. Analog / Proportioning Actuators: Valve or damper position may be assumed to be equal to analog signal to actuator.
 2. Floating Actuators: Provide either a separate position feedback analog input control point, or alternatively, the position may be estimated by timing pulse-open and pulse-closed commands if combined with an auto-zeroing function whenever the damper or valve has been driven full closed. The second option is not acceptable for 24/7 systems / applications that lack an unoccupied mode of operation, unless a forced/override auto-zero is implemented at least once every 48 hours.
 3. Two-Position Actuators: Such valves may be ignored for the purposes of such control loop functions.
- Q. Temperature Alarms: If space temperatures that are monitored through the DDC system fall more than the adjustable alarm levels, the DDC system shall issue an alarm. Recommended alarm settings:
1. High limit for occupied spaces: 84 deg. F.
 2. High limit for data rooms: 80 deg. F.
 3. High limit for other unoccupied spaces: 104 deg. F.
 4. Low limit for occupied spaces: 58 deg. F.
 5. Low limit for unoccupied spaces: 52 deg. F.
- R. Status Monitoring of Motor Driven Equipment: All pump and fan status monitoring shall be achieved through current switches that have an adjustable trip point. Adjust so that setpoint is below minimum operating current and above motor no-load current.
1. Exception: A direct drive fan status obtained through VFD communications may substitute for a current switch.
 2. Additionally, fans with flow measuring stations shall have a proof of flow point via the flow station. If current and air / water flow is not detected within 20 seconds of the signal

for the fan to start, an alarm shall be issued at the operator's workstation and the fan / pump shall be de-energized.

- S. Space Thermostats: All DDC system space temperature sensors, except for those located in corridors, mechanical and electrical rooms, tele-data rooms, toilet rooms, stairways, entry vestibules, lobbies, and storage rooms shall be provided with a local temperature sensor override feature that permits the user to adjust the space temperature setpoint +/- 2 deg. F. (adjustable) away from the space temperature setpoint set by the DDC system via programming. Sensors shall also incorporate an occupancy override pushbutton that provides a binary input to the DDC system to indicate space occupancy.
- T. Run Time Totalization: The DDC system shall provide a run-time totalization feature for all fans, fan-containing equipment, pumps, boilers, fuel burners (e.g. furnaces boilers, etc.), and refrigerant compressors, and all other HVAC equipment controlled by the DDC system except as noted otherwise.
 - 1. Exception: Run-time totalization is not required for cabinet unit heaters, horizontal unit heaters, and any equipment not being controlled or monitored by the DDC system.
- U. Space Command Switch / Pushbutton Signage: Provide engraved plastic laminate signage, in letters minimum 1/2-inch high, at all space fan start/stop momentary contact buttons, timing switches, etc. The signage shall indicate the switch/system function. A red plate with white letters shall be used for emergency functions, and white with black letters shall be used for normal / non-emergency functions.
- V. Freezestats: Freezestats shall be installed in a uniform, horizontal serpentine pattern and in a downward direction from the body of the device. Element shall be exposed to all areas that encounter low temperature, including along the bottom of the coil(s), from end to end. Provide 1 foot of sensing element for each square foot of coil area. Provide as many freezestats as required for full coverage. Freezestats shall be of the automatic reset type, but a freeze trip only released by way of a manual command at the operator's workstation after three automatic re-start attempts within an 8 hour period.
- W. Safety Device Wiring: Unless explicitly noted otherwise, all safety switches/devices (e.g. freezestats, duct pressure limit switches, smoke detectors, etc.) shall be of the automatic reset type but shall provide a digital input (DI) to the DDC system, with software reset required through a manual command at the operator's workstation, with the exception of smoke detectors which shall be hardwired to the appropriate motor controller(s)
- X. Automatic Restart after Power Failure: Upon restoration of power, the equipment controller shall automatically and without human intervention: update all monitored functions; resume operation based on current, synchronized time and status, and implement special start-up strategies as required.
- Y. Air System Maintenance Start-Stop Switches: A maintenance shutdown / start-up switch shall be provided for each AHU. Locate this switch near to the supply fan VFD. The switch shall provide a pair of binary inputs to the DDC system. Whenever the switch is positioned to 'off', the entire air system shall de-energized via software in the manner identical to the manual system shutdown command initiated through the DDC system interface. The 'on' position / input shall re-start the system in accordance with programming.

1. Provide labeling on the supply and relief fan VFDs and disconnect switches referring staff to the maintenance switches for unit shutdown PRIOR to disconnecting power at service disconnect (safety) switches in order to prevent control system alarms.
 2. Provide labeling on the maintenance switches indicating that these switches are for control system software shutdown of the unit only, and that VFDs / disconnect switches must be locked and tagged prior to working on the unit.
- Z. Mixing Damper Control: Mixing dampers (outdoor air and return air) shall be provided with independent actuators (at least one actuator per damper) and independent analog output control signals from the DDC system controller. Single actuators using physically linked dampers and common control output signals are not acceptable.
1. Linearization Tuning: The DDC system shall be configured to utilize only the linearly-responding portion of the full range stroke of each of the mixing dampers, so as to compensate for the non-linear control characteristic of each installed damper (i.e. due to lack of, or excess amount of, damper authority - as installed in the complete air handling system). By way of signal conversion, the full range of controller output (i.e. the full 0-10VDC range) shall correspond to only the portion (limited range) of the damper actuator stroke which allows the damper to function in a linear manner with respect to airflow rate. Example: Only controlling a parallel blade return damper from 0% to 20% open where that damper that has excessively low control authority (i.e. is quite oversized), in lieu of the damper ranging from 0% to 100% open.
 - a. The DDC system sub-contractor shall observe the response of the installed dampers in the system after start up, and during commissioning of the control system, shall determine the required minimum and maximum settings of each damper individually to produce linear response of the air mixing process.
 - b. If no supply airflow measuring station is present in the system, the Testing, Adjusting, and Balancing Agent shall assist in this process by measuring the mixed airflow (same as supply air) variation of the system, at constant fan speed with all terminal unit positions locked in place, over the full range of mixing damper stroke.
 - c. The linearization tuning process shall be considered acceptable when there is no more than 10% variation in mixed/ supply air flowrate over the entire mixing damper control signal range.
 - d. Damper override signals shall permit dampers to be stroked to any degree of open (anywhere from 0 to 100% / fully open).
 - e. Acceptable compliance approaches include:
 - 1) The DDC system supplier may utilize a Belimo SBG 24 Range Controller to achieve this requirement.
 - 2) Alternatively, duct blank-off plates may also be provided to decrease the functional size of dampers to increase control authority and allow for more linear response, but only with the pre-approval of the Architect / Engineer, where the plates do not interfere with the readings of an airflow measuring station, and only as a supplement to the linearization by damper range process. The plates shall be provided by the installing Division 23 Contractor.
 - 3) A custom linearization function to correct for a known (measured) damper position vs. airflow rate curve.

- f. The linearization tuning process shall be considered acceptable when it has been observed and documented by flow measurements that there is no more than 10% variation in mixed/ supply air flowrate over the entire mixing damper control signal range.
- AA. Cascade Loops: Cascade loop methods of control over modulating (analog) output devices (e.g. variable speed supply fans,) shall be utilized wherever required to produce stable control while providing quick response required to prevent problematic operating conditions or safety shutdowns.
 - 1. Example: Heating coil control valves shall be directly piloted from an averaging temperature sensor located immediately downstream of the coil, with the setpoint of that "local" control loop reset as required to provide the desired unit supply air temperature to the spaces, as measured by a temperature sensor in the main supply air duct connected to the air handling unit. The local HW valve control loop shall be quick reacting, with the reset loop slower reacting. By this method, the heating coil can produce proper temperature air quickly in response to rapid changes in upstream variables to prevent freeze/ stat trips or frozen coils, but without the risk of HW valve hunting and other instabilities due to system inertia between the heating coil and the main AHU supply air temperature sensor.
- BB. Duct and Plenum Air Temperature Sensor Applications: Use averaging type temperature sensors in ductwork greater than 48" in any dimension, where air temperature stratification exists (such as a mixed air plenum), immediately downstream of air blenders, and immediately downstream of any heat exchanging element (coil, furnace, etc.).
- CC. Dead-bands: Control loops shall incorporate dead-bands of an appropriate range in order to prevent 'hunting' or excessive 'cycling' of the output device (e.g. variable speed fan controlled to remote duct static pressure, space temperature sensor controlling an on-off exhaust fan, etc.). Dead-band ranges shall be adjustable, with proposed initial settings indicated on the ATC primary submittal.
- DD. Warm-Up and Cool-Down Modes: Air handling units and similar air systems with time of day schedules (i.e. not continuous operation) shall incorporate warm up and cool down cycles. The units shall be operated in advance of an occupancy period, with a minimum outdoor airflow rate of zero (0) cfm. The duration of this warm up / cool down period shall be auto-adaptive and dependent on the outdoor air temperature and at least one representative space temperature input signal.
- EE. Airflow Measurement of Fan Arrays: The DDC system shall monitor the airflow rate of each individual fan in the array, and shall sum the airflow values from all operating fans to determine the total airflow rate of the array.

PART 2 - PRODUCTS

2.1 CONTROLS SYSTEM ARCHITECTURE

- A. General: The web-based Building Automation System shall encompass the HVAC control system. The BAS shall be controlled through a single graphical, web-based operator interface that allows for instant access to any sub-system through a standard browser. System requiring two or more different PC workstations are unacceptable.
- B. The network architecture shall consist of different levels of networks:
 - 1. The Management level shall utilize BACnet/IP over Ethernet along with other standardized protocol, such as web services, html, JAVA, SOAP, XML, etc., to transmit data to non-BAS software and databases.
 - 2. The Automation Level Network shall be Ethernet or BACnet/IP over Ethernet. It shall network the Automation Server (if present), operator workstations, and NAC / BC level controllers. Provide network media converters, hubs, routers and switches as necessary for a complete network.
 - 3. The Field Level Network shall be BACnet over MS/TP. It shall network to all of the DDC controlled equipment on a floor or in a system and network to a router that connects to the automaton level BAS backbone.
 - a. Controllers for the central plant and large infrastructure air handlers may reside on either the backbone BACnet/MS/TP or on the BACnet/IP over Ethernet network.
 - 4. Proprietary protocol communication will not be accepted.
- C. Ethernet Network switches, as required, shall be strategically placed through the building to cover several floors or several mechanical rooms that are within 300 ft. wiring-feet of each other.
- D. The Building Level Controllers (BCs) shall be able to support subnetwork protocols that may be needed depending on the type of equipment or application. Subnetworks shall be limited to:
 - 1. BACnet MS/TP
 - 2. Modbus
- E. Application specific controllers for smaller single zone, supplemental or special systems can reside on the BACnet/IP network or on a sub-network.
- F. Field level controllers, terminal units, package AC units, auxiliary equipment, VFDs, meters shall reside on one of the sub-networks above.
- G. Provide all communication media, connectors, repeaters, bridges, switches, and routers necessary for the internet work.
- H. Use fiber for all Ethernet runs longer than 300 ft.
- I. Controllers and software shall be BTL listed at the time of installation.

- J. Provide all communication media, connectors, repeaters, bridges, switches, and routers necessary for the internet work.
 - 1. The system shall meet peer-to-peer communication services such that the values in any one (1) Building Controller (BC) or Advanced Application Controller (AAC) can be read or changed from all other controllers with the need for intermediary devices. The software shall provide transparent transfer of all data, control programs, schedules, trends, and alarms from any one controller through the internet to any other controller, regardless of subnetwork routers.
 - 2. Systems that use variations of BACnet using Point-to-Point (PTP) between controllers, gateways, bridges or networks that are not peer-to-peer are not allowed.
 - 3. Remote Communications: Provide a TCP/IP compatible communication port for connection to the Owner's network for remote communications. Provide coordination with the Owner for addressing and router configuration on both ends of the remote network.
 - 4. Where a smoke control application is required, provide UUKL listed network switches, cabling, enclosures and installation methods.

- K. Network communications shall be limited to BACnet Ethernet TCP/IP, BACnet MS/TP, and BACnet IP.
 - 1. The use of ARCNET or ARC156 is not acceptable.
 - 2. The use of BACnet PTP / EIA-232 is not acceptable.
 - 3. The use of LonTalk is not acceptable.

- L. HVAC controllers shall be designed in strict accordance with ASHRAE's BACnet standard to provide interoperability between different building subsystems. The system shall use BACnet network types and protocols exclusively.
 - 1. Non-BACnet based systems are not acceptable.
 - 2. Contractor shall provide manufacturer's Protocol Implementation Conformance Statement (PICS) for every controller model that are installed.

- M. The system shall utilize ASHRAE BACNet Standard 135-2012 as the communication protocol to the web browser interface.

- N. The networks shall utilize only copper and/or optical fiber communication media.

2.2 MANAGEMENT LEVEL SYSTEM

- A. General: The servers and principal network computer equipment, as applicable shall be standard products of recognized major manufacturers available through normal PC and computer vendor channels – not "Clones" assembled by a third-party subcontractor. Provide licenses for all software residing on and used by the Controls Systems and transfer these licenses to the Owner prior to completion. The networks shall, at minimum, comprise, as necessary, the following
 - 1. Building Automation Server
 - a. Provide only if required by the number of control points defined by the sequences of operation and other provisions of this Contract.

- b. The NAC is permitted to perform the functions of a server, provided that it meets all other requirements of this Contract.
 - 2. Network Area Management Controller (NAC)
 - 3. Operator Interface GUI software,
 - 4. Operator Work stations and Web User Interface as explained below
- B. Acceptable Platforms: Tridium Niagara 4 Framework using a VYKON Network Area Controller (NAC) as the head end controller, or equivalent from that of a Tridium OEM Partner listed below:
- 1. Distech Controls – 'EC-Net'
 - 2. Johnson Controls Inc. - 'Facility Explorer'
 - 3. Lynxspring – 'Jenesys'
 - 4. Siemens –'Talon Manager'
- C. The programmer / installer / system integrator of the operator interface shall have a current Niagara 4 certification. Evidence of this certification shall be submitted to the Architect / Engineer upon request.

2.3 BUILDING AUTOMATION SERVER

- A. Provide a PC for the BAS Server database, but only if explicitly made necessary by other provisions of the Contract. Provide the latest model of the nominal speed, RAM and memory for a commercial office grade PC from a named brand manufacturer. Minimum requirements and accessories shall be:
- 1. Processor: Intel “i5” series or AMD equal
 - 2. 3GHz processor speed minimum 6M cache
 - 3. 4GB Ram, Dual Channel, DDR3 SDRam at 1333MHz minimum
 - 4. 16x R/W CD and DVD
 - 5. 500GB Hard disk space, 7200RPM
 - 6. USB Ports
 - 7. NIC Card
 - 8. 101 key enhanced keyboard, Mouse, power strip
 - 9. UPS for 15-minute backup
- B. Provide an active matrix LCD, flat panel type monitor that supports a minimum display resolution of no less than 1600 × 1200 pixels, Energy Star compliant. The display shall have a minimum of 20-inch visible area in diagonal measurement. Separate controls shall be provided for color, contrasts and brightness. The screen shall be non-reflective.
- C. Printer: Provide a compatible inkjet or laser printer for alarms and reports. Provide drivers.
- D. Locate the BAS Server in a clean, secure, dry and temperature controlled environment identified and provided by the Owner.
- E. The server shall reside on the same Ethernet or BACnet/IP over Ethernet network as the NAC Controller(s).

- F. Provide software licenses for interfacing to the BAS. Load software, configure and setup for viewing the BAS system.
- G. Provide the PC with the most current Windows operating system, compatible with the BAS software.

2.4 OPERATOR WORKSTATION

- A. General: The application software shall be capable of communication to all automation and field level controllers, feature high-resolution color graphics, alarming, reporting, and be user configurable for all data collection and data presentation functions.
- B. No fixed or portable computer workstation hardware is required. All workstation functions shall be accomplished by way of the web server.

2.5 NETWORK AREA CONTROLLER (NAC):

- A. The Building Management and Control System shall be comprised of Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the owner's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to BACnet (IBC) controllers and other open and legacy protocol systems/devices.
- B. The Network Area Controller as provided in this Division shall be based on the Niagara Framework (or "Niagara"), a Java-based framework developed by Tridium. Niagara provides an automation infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard or software) into a unified platform that can be managed in real time over the Internet using a standard Web browser. Number of Area controllers to be configured based on the configuration.
- C. The ATC contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided under Division 23. It is the responsibility of the contractor to configure the architecture to determine the quantity and type of devices.
- D. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
 - 1. Calendar functions
 - 2. Scheduling
 - 3. Trending
 - 4. Alarm monitoring and routing
 - 5. Time synchronization
 - 6. Integration of controller data through Niagara 4 drivers installed in the NAC.
 - 7. Network Management functions for all controllers

8. The Network Area Controller must provide the following hardware features as a minimum, unless trend data storage requirements specified below are more demanding:
 - a. One (1) Ethernet Port – 10/100 Mbps
 - b. One (1) RS-232 port
 - c. One (1) RS-485 port
 - d. Battery Backup
 - e. Flash memory for long term data backup (if battery backup or flash memory is not supplied; the controller must contain a hard disk with at least 1 GB storage capacity).
 - f. The NAC must be capable of operation over a temperature range of 32 to 122°F
 - g. The NAC must be capable of withstanding storage temperatures of between 0 and 158°F
 - h. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing.
 - i. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

9. Storage capacity available for trend data, alarm / event histories, transaction logs, and similar data shall be no less than the equivalent amount required to store time-stamped trend data for every field control point on the control system every 15 minutes for one (1) year.
 - a. A database server or an NAC with greater storage capacity than that specified above may be provided to meet this requirement.

- E. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

2.6 NAC / AUTOMATION LEVEL NETWORK

- A. The DDC system's Automation Level Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), operator's workstations, web servers, and, if required, a building automation server.

- B. Local area network minimum physical and media access requirements:
 1. Ethernet: IEEE standard 802.3
 2. Cable: 100 Base-T, UTP-8 wire, category 5
 3. Minimum Throughput: 100 Mbps.

- C. The Controls Systems shall be designed and implemented for use and operation on the Internet and the Owner's Intranet. This functionality for operational access shall extend down to the field level controllers and field point level. All controls systems application facilities and features shall be accessible via the Owners Intranet and Internet Browser with user ID or Password access control for user access.

D. Internet Network Access and Use of the Owner's WAN/LAN:

1. The ATC Contractor shall provide access to the Network Area Controller (or automation server, if provided) from a remote location, via the internet. To enable this access, the Owner will provide a connection to the internet via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's intranet to a corporate server providing access to an Internet Service Provider (ISP). The Owner will agree to pay monthly access charges for the connection and ISP.
2. The DDC system networks shall be completely independent from the Owner's WAN/LAN, except for the internet connection described above. The Internet connection shall be to the NAC or building automation server. Any additional networking between Tier 1 controllers or from the NAC / building automation server and Tier 1 controllers or web server shall be the responsibility of the ATC Contractor.
3. The ATC Contractor shall identify the specific Internet and Owner's WAN/LAN access requirements, including locations, in the primary submittal. The ATC Contractor shall provide the IT interfacing equipment and shall coordinate on configuration and interfacing arrangements with the Owner's IT staff.
 - a. All DDC system cabling connecting to the Owner's LAN shall be in full compliance with the Owner's requirements.
4. The DDC system Field Level network shall be completely independent of the Owner's building WAN/LAN. The networking between ASCs, AACs, and other Field Level controllers and the NAC or Automation Server on the Automation Level network shall be the responsibility of the ATC Contractor.

2.7 EVENT ALARM NOTIFICATION AND ACTIONS

- A. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
- B. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
- C. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 1. To alarm
 2. Return to normal
 3. To fault
- D. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
- E. Provide timed (schedule) routing of alarms by class, object, group, or controller.
- F. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

- G. Control equipment and network failures shall be treated as alarms and annunciated.
- H. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1. Screen message text
 - 2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 - 3. Pagers via paging services that initiate a page on receipt of email message
- I. Graphic with flashing alarm object(s)
- J. Printed message, routed directly to a dedicated alarm printer
- K. The following shall be recorded by the NAC for each alarm (at a minimum):
 - 1. Time and date
 - 2. Location (building, floor, zone, office number, etc.)
 - 3. Equipment (air Handler #, accessway etc.)
 - 4. Acknowledge time, date, and user who issued acknowledgement.
 - 5. Number of occurrences since last acknowledgement.
- L. Alarm actions may be initiated by user defined programmable objects created for that purpose.
- M. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- N. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.
- O. Provide a “query” feature to allow review of specific alarms by user defined parameters.
- P. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- Q. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.8 DATA COLLECTION AND STORAGE

- A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.
- B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.
2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
6. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.
7. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
8. All log data shall be available to the user in the following data formats:
 - a. HTML
 - b. XML
 - c. Plain Text
 - d. Comma or tab separated values

C. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

D. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to an external server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:

1. Archive on time of day.
2. Archive on user-defined number of data stores in the log (buffer size).
3. Archive when log has reached its user-defined capacity of data stores.
4. Provide ability to clear logs once archived.

2.9 AUDIT LOG

A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

1. Time and date
2. User ID
3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

2.10 DATABASE BACKUP AND STORAGE

- A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
- B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
- C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.11 GRAPHICAL USER INTERFACE (GUI)

- A. General: The Controls Systems Operator Interface Software shall be user friendly, readily understood and shall make maximum use of colors, graphics, icons, embedded images, animation, text based information and data visualization techniques to enhance and simplify the use and understanding of the displays by authorized users at the Operator's Workstation.
 - 1. User access shall be protected by a flexible and Owner re-definable software-based password access protection. Password protection shall be multi-level and partitionable to accommodate the varied access requirements of the different user groups to which individual users may be assigned. Provide the means to define unique access privileges for each individual authorized user. Provide the means to on-line manage password access control under the control of a project specific Master Password. Provide an audit trail of all user activity on the Controls Systems including all actions and changes.
 - 2. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
 - a. User access for selective information retrieval and control command execution.
 - b. Monitoring and reporting.
 - c. Alarm and non-normal condition annunciation.
 - d. Selective operator overrides and other control actions.
 - e. Information archiving, manipulation, formatting, display and reporting.
 - f. Controls Systems internal performance supervision and diagnostics.
 - g. On-line access to user HELP menus.
 - h. Provide on-line reports and displays making maximized use of simple English language descriptions and readily understood acronyms, abbreviations, icons and the like to assist user understanding and interpretation.
 - i. All devices, including OWS, servers and controllers, required to support and drive the Operator Interfaces shall support multiple independent user terminals through a theoretical unlimited number of Browsers. Support shall be configured for minimum of (25) users for all applications and features provided.
- B. Controls Applications:
 - 1. Provide a color graphic system flow diagram display for each HVAC system with all points as indicated on the point list. Provide Historical Data Viewer functionality.
 - 2. Provide a text sequence of operation for each system launched from the graphic.

3. Provide a color graphic display for each floor in the facility. Indicate each HVAC zone, color coded to indicate zone values and status.
 4. Provide DDC System configuration diagrams and bill-of-material for all provided equipment on-line and able to be launched from the OWS.
 5. The GUI shall include navigation with logical grouping of the equipment into equipment summary screens such that all the VAV boxes being fed air from a particular AHU can be displayed together for comparison.
 6. The GUI shall include Air Handler unit roll up screens showing the min/max and average airflow devices in the family of equipment and provide for a means to quickly reset static discharge set point for more efficient controls.
 7. The GUI shall logically group graphics navigation by tenant so that in a multi-tenant building, only the equipment graphics associated with the tenants' space can be easily viewed.
 8. The Custom Equipment graphics for VAV boxes shall allow the user to initiate the creation of trend storage and collection of a system point through a simple drag and drop. Each custom VAV equipment graphic shall have the ability to display the detailed sequence of operations controlling the space from within each unique device and/or application.
- C. The GUI shall provide a completely interactive user interface and must offer the following features as a minimum:
1. Operating System: The GUI shall run on Microsoft Windows Operating Systems and/or standard Internet browsers including Internet Explorer, Firefox, and Chrome.
 2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
- D. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- E. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- F. Alarm Console:
1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the

alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.12 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Chrome.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the System, shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
 1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
- E. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 1. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 2. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 3. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

4. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 5. View logs and charts.
 - a. View and acknowledge alarms
 - b. Setup and execute SQL queries on log and archive information
- F. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
- G. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.13 FIELD LEVEL SYSTEM ARCHITECTURE

- A. The Field Level controls system shall consist of a complete peer-to-peer networked, distributed Direct Digital Control System of automatic temperature control. The Field Level system shall provide control of HVAC including RTUs, and other mechanical equipment as specified in the Drawings. Each controller shall be fully programmable, contain its own control programs and will continue to operate in the event of a failure or communication loss to its associated Network Area Controller (or Server, if applicable).
1. The Field Level DDC system network shall be completely independent of the existing building WAN/LAN.
- B. All field level controllers used on the project shall be available through distributor channels so that replacement controllers are not available from a sole source. Any controllers that are only available through manufacturer's factory offices or factory authorized offices with non-competitive sales territories are not acceptable.
- C. System Controllers: Each Direct Digital Controller shall exchange information on a peer to peer basis with other Standalone digital controllers, using the BACnet MS/TP protocol. Each DDC shall be capable of storing and referencing global variables (on the LAN) with or without any workstations online. Each DDC shall be able to have its program viewed and/or enabled/disabled through a workstation connected to a Network Controller.
1. The system controllers shall include all monitoring, control and data handling controllers including programmable field panels and controllers.
 2. Controllers shall be programmable and governed by the requirements of their applicable codes, approvals and regulations for their Application.
 3. Controllers shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this Project.

4. A failure at a controller shall not cause failures or non-normal operation at any other system controller other than the possible loss of active real-time information from the failed controller.
 5. Ancillary equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.
 6. Controllers shall comply with FCC Part 15 subpart J Class A emission requirements.
 7. Controllers shall maintain all programming in non-volatile or battery backed memory and shall automatically resume normal monitoring and control following the restoration of stable electrical power after a power outage.
 8. Each primary system controller shall be provided with the necessary un-interruptible power facilities to ensure its continued normal operation during periods of line power outages of, at minimum, 1-minute duration. This normal functionality shall include all normal software processing, communication with powered field devices and network communications with other powered system controllers, servers and OWS.
- D. BACNet Standards: The system shall utilize ASHRAE BACnet Standard 135-2012 as the communication protocol from controller-to-controller. Proprietary controllers will not be accepted. Controllers include both advanced application controllers (AACs) and application specific controllers (ASCs).
1. Controller to controller communication shall be by BACnet communications.
 2. The Controls Systems Application network shall utilize open architecture as follows:
 - a. Standard Ethernet TCP/IP communications operating at a minimum speed of 10/100 Mb/sec.
 - b. BACnet/IP in accordance with ANSI/ASHRAE Standard 135-2012 at the Building Automation Level.
 - c. BACnet MS/TP in accordance with ANSI/ASHRAE Standard 135 2012 at the Field Level.
 - d. Proprietary protocol communication will not be accepted
- E. Building Level Controllers (BCs): Shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing
1. Building controllers shall support firmware upgrades without the need to replace hardware and shall have a minimum of [5][10][15][20] percent spare expansion capacity in total system points and programming functions, and number of Field Level controllers connected.
- F. Advanced Application Controllers (AACs): Shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
1. Such controllers shall be provided for each major system or piece of equipment, such as air handling units, rooftop units, chilled water system, hot water system, etc.
 2. Provide point expansion modules where required so that each AAC shall have the following minimum spare point capacities available for future field device connections:

- a. Analog Inputs: 10% of the number utilized on the project or three (3), whichever is larger.
 - b. Analog Outputs: 10% of the number utilized on the project or three (3), whichever is larger.
 - c. Binary Inputs: 10% of the number utilized on the project or three (3), whichever is larger.
 - d. Binary Outputs: 10% of the number utilized on the project or three (3), whichever is larger.
 - e. Universal / configurable points may not be counted twice in order to meet the above requirements.
- G. Application Specific Controllers (ASCs): Application specific controllers (ASCs) shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
- 1. Such controllers (ASCs) shall only be acceptable for smaller room-level equipment such as radiant panels, fan coil units, unitary heat pumps, fin tube radiators, VAV boxes, cabinet heaters, chilled beams, etc.
 - 2. Provide point expansion modules where required so that each ASC shall have the following minimum spare point capacities available for future field device connections:
 - a. Analog Inputs: No less than one (1).
 - b. Analog Outputs: No less than one (1).
 - c. Binary Inputs: No less than one (1).
 - d. Binary Outputs: No less than one (1).
 - e. Universal / configurable points may not be counted twice in order to meet the above requirements.
- H. Real Time Clock (RTC): The DDC shall have a real time clock in either hardware or software. The accuracy shall be within 10 seconds per day. The RTC shall provide the following information: time of day, day, month, year, and day of week. Each SDCU shall receive a signal, every hour, over the network from the Network Controller, which synchronizes all DDC real time clocks.
- I. Automatic Restart After Power Failure: Upon restoration of power, the DDC shall automatically and without human intervention, resume operations based on current and implement special start-up strategies as required.
- J. Controllers shall contain flash memory to store both the resident operating system and the application software.
- K. Each controller shall have enough inputs and outputs to meet the application's required point count. Each DDC shall support universal inputs and Outputs to meet the application. For larger controllers, shall have provision to expand input and output points through the use of expansion modules.
- L. A manual override switch shall be provided for all digital and analog outputs on controllers. The position of the switch shall be monitored in software and available for operator displays and alarm notification.

2.14 THIRD-PARTY INTERFACES

- A. DDC Contractor shall integrate real-time data from building systems by other trades and databases originating from other trades as specified and required by the Contract Documents.
- B. The Controls Systems shall include necessary hardware, equipment and software to allow data communications between the Controls Systems and building systems supplied by other trades. All other devices must be definable digital inputs, analog inputs, or BACnet MS/TP or IP communication capable supplied by the source provided trades.

2.15 POWER CONDITIONING

- A. Protect DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:
 - 1. At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
 - 2. During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
 - 3. Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
 - 4. Total harmonic distortion shall not exceed 3-1/2 percent at full load.
- B. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

2.16 CONTROL PANELS

- A. Provide control panels with suitable brackets for wall mounting for each control system. Locate panel adjacent to systems served.
 - 1. Fabricate panels of 16-gage furniture-grade steel, totally enclosed on four sides, with piano hinged door and keyed lock, with manufacturer's standard shop-painted finish and color.
 - 2. Provide UL-listed cabinets for use with line voltage devices.
 - 3. All panels powered by 120VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the controller manufacturer. This protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor (min. 12 AWG) shall be brought to each control panel.
 - 4. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip. Control panel shall have standard manufacturer's color.
 - 5. All gauges and control components shall be identified by means of nameplates.
 - 6. All control tubing and wiring shall be run neatly and in an orderly fashion in open slot wiring ducts with cover.
 - 7. Do not loop or coil excess wire in cabinet.
 - 8. There shall be no drilling on the controller cabinet after the controls are mounted inside.
 - 9. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.

10. Complete wiring and tubing termination drawings shall be mounted in or adjacent to each panel.
11. Indoor cabinets shall be NEMA 1 construction, unless noted otherwise. Cabinets located outdoors shall be NEMA 4X.
12. A paper copy of the system control schematics from the as-built documentation, including I/O lists, control diagram identifying devices, etc., shall be provided in a plastic sleeve secured to the inside of the control panel door. A laminated, reduced size of the control diagram shall also be installed on the outside face of the panel.

2.17 SEPARABLE SOCKETS (THERMOWELLS)

- A. Comply with requirements Division 23 Section "Meters and Gages for HVAC Piping", including the use of heat-transfer compound.

2.18 PIPING, TUBING, AND VALVES

- A. Air Pressure Instrument Signal Tubing and Piping:

1. Products in this paragraph are intended for use with the following:
 - a. Signal air between pressure instruments, such as sensors, switches, transmitters, controllers and accessories.
 - b. Pressure signals to instruments connected to hydronic systems.
2. Copper Tubing:
 - a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered, with chemical and physical properties according to ASTM B 75.
 - b. Performance, dimensions, weight and tolerance according to ASTM B 280.
 - c. Diameter, as required by application, not less than nominal 0.25 inch.
 - d. Wall thickness, as required by the application, but not less than 0.030 inch.
3. Copper Tubing Connectors and Fittings: Brass, compression or solder joint type.
4. Polyethylene Tubing (Air Signals ONLY):
 - a. Fire-resistant black virgin polyethylene according to ASTM D 1248, Type 1, Class C and Grade 5.
 - b. Tubing shall comply with stress crack test according to ASTM D 1693.
 - c. Diameter, as required by application, of not less than nominal 0.25 inch.
5. Polyethylene Tubing Connectors and Fittings (Air Signals ONLY): Brass, barbed fittings or compression type fittings.

- B. Air Static Pressure Tips:

1. Duct Applications: Constructed of brass or stainless steel tubing, with a mounting flange and a 90 degree bend, with four (4) 0.040" diameter, radially drilled sample holes located

- near the tip and set a minimum of 4" away from the duct or plenum wall. Dwyer A-301 or A-302 series, or approved equal.
2. Indoor Room Pressure Applications: Constructed of stainless steel, with a mounting flange for finished ceiling or wall installation. Dwyer A-414 or approved equal.
 3. Outdoor Building Pressurization (Differential Pressure Measurement) Applications: Dwyer A-306 series probe for the low (outdoor) side with a Modus pneumatic surge dampener piped to both the high and low ports, or approved equal. Locate the outdoor probe as far away from building walls and other turbulence inducing objects/ obstructions as possible. Terminate the indoor probe in the ceiling space. The differential pressure sensor shall be located indoors and piping extended to the outdoor probe.

2.19 CONTROLS SYSTEMS FIELD DEVICES

A. Input Devices:

1. Airflow Low Differential Pressure Switch:
 - a. Rating: NEMA 1
 - b. Mounting: Duct Insertion.
 - c. Range: 0.05" to 5.0" WC, complete with field adjustable setpoint.
 - d. Protection: Overpressure to 1 PSIG
 - e. Output: Form C Contact, minimum 50VA
 - f. Reset: Automatic or manual reset as required by the sequence of operation.
 - g. Accessories: Provide complete installation kit including static pressure tips, tubing, fittings and air filters.
2. Airflow High Differential Pressure Switch:
 - a. Rating: NEMA 1
 - b. Mounting: Duct Insertion
 - c. Range: 1" to 10" WC, complete with field adjustable setpoint
 - d. Protection: Overpressure to 1 PSIG
 - e. Output: 2 Form C Contacts, minimum 360VA
 - f. Accessories: Provide complete installation kit including static pressure tips, tubing, fittings and air filters.
3. Space-to-Outdoor Air Low Differential Pressure Transducer:
 - a. Product: Ebtron 'EF-x2000-B' series bleed-orifice type differential pressure sensor and transmitter, no substitutions.
 - b. Mounting: Ceiling-space/plenum mounted, unless room mounting is indicated on the Drawings. 50 Ft long plenum rated cable between sensor and transmitter.
 - c. Range: -0.5 to +0.5 (inches of Water Column).
 - d. Accuracy: 2% of reading.
 - e. Thermal Effect Compensation Range: -20 to 120 Degrees F
 - f. Output: 0-5 or 0-10 VDC, linear.
 - g. User Interface: LCD display.
 - h. Warranty: 3 years.

- i. Installation for Space to Outdoor Air Sensing: Locate the sensor and transmitter indoors. Pipe each end of the sensor with copper tube sized as recommended by the manufacturer for the length of run and number of fittings proposed. Provide mesh screened wall/ceiling plates on each side of the sensor. Provide a stainless steel rain shield for the exterior termination. Paint the rain shield with exterior grade polyurethane paint matching the adjacent building surface color. Perform the manufacturer-recommended field adjustments / calibration.
4. Air Differential Pressure and Static Pressure Sensors:
- a. Enclosure Rating: NEMA 1 (indoors) or 4X (outdoors). Installing exterior units inside a field-provided NEMA 4X enclosure is also acceptable.
 - b. Accuracy: +/- 0.5% of natural span.
 - c. Mounting: Duct Insertion
 - d. Range: 0.05" to 5.0" WC
 - e. Protection: Overpressure to 1 PSIG
 - f. Output: 0-10vDC, 4-20mA
 - g. Accessories: Provide complete installation kit including static pressure tips, tubing, fittings and air filters.
5. Water Differential Pressure Transducer With Three Valve Manifold (for pump VFD control):
- a. Provide differential pressure transmitter with three-valve Manifold.
 - b. Rating: NEMA 1.
 - c. Mounting: Pipe mounted.
 - d. Range: 0-25 PSI unidirectional
 - e. Accuracy: +/-0.25% of full scale.
 - f. Protection: 150 PSIG
 - g. Output: 4-20mA, 0-5 VDC, 0-10 VDC.
 - h. Accessories: Needle valves and snubbers.
 - i. Acceptable Manufacturer:
 - 1) Transducer: Kele Model # 230, or approved equal by Veris.
 - 2) Three valve manifold: Kele Model # M230-3VLV, or approved equal.
6. Duct / Plenum Low Temperature Switches (FreezeStats): Capillary tube type with continuous sensing of temperature. Freezestats with discrete temperature sensing points are not acceptable.
- a. The low temperature limit switch shall be of the automatic reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
 - b. The sensing element of each freezestat shall be a minimum of 20 feet in length and shall react to the coldest 12 inch section.
7. Duct High Temperature Switches:
- a. The high temperature limit switch shall be of the automatic reset type with Single Pole / Double throw that opens with rise in temperature.
 - b. Unit shall be UL approved

- c. Unit shall have an adjustable set point from 100 to 250 Degrees F with a 25 Degrees F differential deadband.
 - d. The sensing element shall be 5" or 11" in order to fit the application.
 - e. High Temperature Limit Switch shall be Kele Model TC-105 or TC-100, or approved equal.
8. Duct Temperature Sensors (Single Point): Platinum 1000 Ohm RTD type.
- a. Materials: Nickel element in a copper sheath.
 - b. Range: -50°F to 250°F
 - c. Accuracy: 0.1%
 - d. Drift: Within 0.5 deg. F. over 10 years.
 - e. Special: Duct element holder and cover.
9. Duct and Plenum Temperature Sensors (Averaging): Platinum 1000 ohm RTD type, with continuous wire strands to provide average temperature across entire length of sensor element. Averaging sensors with discrete sensing points (i.e. thermistor type) are not acceptable. The sensor shall have a sintered moisture protection coating protecting against condensation, mechanical stress, and vibration.
- a. Range: -50°F to 250°F
 - b. Accuracy: 0.1%
 - c. Drift: Within 0.5 deg. F. over 10 years.
 - d. Special: Probe brackets to support turns in the element and prevent vibration during system operation.
 - e. Length: As required by application to cover entire cross section of air tunnel or duct.
10. Relative Humidity Sensors: Thin-film capacitive type or complementary metal oxide semiconductor (CMOS) type, with nonvolatile memory.
- a. Mounting: Duct or Wall.
 - b. Range: 10% to 90%.
 - c. Accuracy: +/-2% of full scale.
 - d. Long Term Drift: +/- 0.25%
 - e. Protection: 0-100% non-condensing.
 - f. Output: 0-10vDC, 4-20mA.
 - g. Special: Duct or wall mounting kit.
 - h. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Belimo
 - 2) Vaisala
 - 3) BAPI
 - 4) Setra
11. DDC System Room Thermostats / Temperature Sensors:
- a. Room thermostats shall be compatible with the zone controller, as specified in the sequence of operation.

- b. The temperature sensor shall be of the 1000 Ohm platinum or nickel RTD, or minimum 10k ohm thermistor type.
 - 1) Resolution: +/- 0.2°F
 - 2) Control Accuracy: +/- 0.9°F
 - 3) Temperature Limits: -40°F to 120°F
 - 4) Temperature Range: As required by application
 - c. Thermostats shall have a setpoint slider, dial, or pushbuttons (with remote adjustability limiting).
 - d. Thermostats shall be provided with room setpoint and current space temperature readout (backlit LCD display) integral to the main body of the thermostat. The setpoint value shall be the actual value, not a +/- local override amount.
12. Damper Position Switches (End Switches): Encapsulated (non-mercury) switch mounted on the damper crank arm. The use of auxiliary contacts on the actuator to indicate position is not acceptable. The switch shall be able to be mounted on a damper control shaft to give an indication of opened and closed damper position. The switch shall be open when the cable end of the switch is horizontal or above. The switch shall make when the cable end drops more than 15 degrees below horizontal. The unit shall have two (2) SPDT switches, plenum rated cable, and stainless steel housing.
- a. Switch shall be rated for outdoor use and rated at a minimum of 2A @ 120VAC
 - b. Acceptable Manufacturer: Kele 'TS-475' series, or approved equal.
 - 1) A Kele 'TS-407' series encapsulated mercury type end switch may be acceptable where space constraints prohibit the use of the larger roller ball type. Confirm with the Owner that the use of an encapsulated mercury switch is acceptable prior to installation.
13. Vibration Switches:
- a. Acceleration sensitive devices that measure the total peak vibratory shock. The device shall provide electric switch contact closure for shutdown of fans, pumps, or compressors. The device shall be DPDT for direct wiring to the equipment and to the DDC system.
 - b. The setpoint shall be field adjustable between 0 and 4.5 Gs in a frequency range of 0 to 50 Hz. The device shall be automatic reset. The setpoint shall be as recommended by the equipment (e.g. fan) manufacturer.
 - c. The main set of contacts shall be wired directly to the fan, pump, or compressor starter; the auxiliary set shall be wired to the DDC system.
 - d. Manufacturer: Vibra-Alert Model 5173 or 5175 vibration switches, or approved equal.
14. Airflow Switch: Two-port operating a spring loaded diaphragm with adjustable setpoint activated by air pressure, incorporating protection against three times working pressure, and switching dry contacts.
15. Current Switch:
- a. Materials: Encased copper.

- b. Rating: 600vAC.
 - c. Mounting: Split Core.
 - d. Range: 1.5 amps to 50 amps.
 - e. Action: Trip point adjustment.
 - f. Output: SPST, N.O.
 - g. Special: Status LED
16. Remote Current Switch / Command Relay Combination:
- a. Mounting: Panel or Electrical Box
 - b. Range: .5 to 16 Amps
 - c. Trip Set-point: Adjustable
 - d. Sensor Power: Induced
 - e. Max. Operating Voltage: 250 VAC
 - f. Frequency Range: 50/60 Hz.
 - g. Humidity Range: 0 to 95% non-condensing
 - h. Operating Temperature: -15° to 60°C
 - i. Status Output: 1.0A @ 30 VAC/DC
 - j. Switch shall have HOA switch to override and troubleshooting
 - k. Switch shall include belt loss detection feature.
 - l. Manufacturer: Hawkeye H548 series, or approved equal
17. Current Transducer:
- a. Mounting: Field Mounted.
 - b. Range: 60 Hz nominal.
 - c. Accuracy: +/-2% full scale.
 - d. Protection: 250 A max current.
 - e. Output: 4-20mA.
18. Duct, Plenum, and Un-ducted Air Intake Mounted Airflow Measuring Stations: Multiport, self-averaging thermal dispersion tube station using sealed thermistors. Sensor density shall be no less than that required to produce the sensing accuracy specified below for the installed conditions of this Project. Each thermistor pair location shall independently measure velocity of the airstream, and the transmitter shall average those velocities for overall airflow rate measurement. Stations using RTDs are not acceptable.
- a. Power Requirement: 24 VAC.
 - b. Calibrated Velocity Range: 0 to 5000 fpm.
 - c. Sensing Point Accuracy:
 - 1) Flow: $\pm 5\%$ of reading in installed system, and on each individual sensor, with a NIST traceable factory calibration on each sensor. Accuracies shall be over a range of zero (0) to 5,000 feet per minute (fpm) air velocity.
 - 2) Temperature: $\pm 0.15^\circ$ F.
 - d. Sensor Probes: Aluminum alloy tube with type 304 stainless steel mounting brackets.

- e. Signal Output: Analog (4-20mA, 0-5VDC or 0-10VDC) for airflow and temperature.
 - 1) Humidity Sensing Option: Analog (4-20mA, 0-5VDC or 0-10VDC) output for enthalpy or dewpoint. Sensor shall be a ruggedized capacitive polymer relative humidity sensor, with a minimum accuracy of +/-2% RH in a range of 20 to 80 % RH, and +/- 3.5% RH elsewhere. Long term drift shall not exceed 0.5% RH/year. Transmitter shall include calculated measurements for enthalpy and dew point using measured RH%, velocity-weighted temperature and on-board barometric pressure sensor. If the airflow station does NOT offer humidity sensing, the DDC system sub-contractor shall provide a separate humidity sensor, calculations, and barometric pressure compensation as specified above.
- f. BAS Interface: BACnet IP or MS/TP communication interface.
- g. Transmitter / User Interface: LCD display of temperature, velocity, and actual cfm. Enclosure shall be NEMA 4 or 4X, with weatherproof cable connections.
- h. Manufacturer's Warranty: 3 years.
- i. Acceptable Manufacturers: Subject to requirements, provide products by one of the following:
 - 1) Ebtron 'Advantage 4 Gold GTx116' Series
 - 2) Ruskin 'TDP05k' Series

19. Fan Inlet Airflow Measuring Stations: Thermal dispersion type, as generally described above for ductwork and plenum mounted stations, and manufactured by Ebtron ('Advantage IV Gold GTx108' series), Air Monitor Corp., or Ruskin, but with a $\pm 3\%$ of reading accuracy in a calibrated velocity range of 0 to 10,000 feet per minute air velocity. Provide 'face-mounted' type thermal dispersion stations (not 'throat-mounted'). Face type mounting shall utilize no mechanical fastening in the fan inlet throat or on the curved surface of the inlet bell, so as to preserve the performance-of the fan, however provide offset brackets to mount the sensors themselves further back in the fan throat. For fan arrays with fan staging control, provide a separate transmitter for each fan inlet station.

- a. At the Contractor's option, a piezo ring fan inlet station may be used on fan inlets in lieu of the above specified thermal dispersion station. The airflow station itself (probes, tubing, etc.) shall be furnished by the equipment / fan manufacturer, with the station K-factor determined from the as-installed condition and field calibration. Stations furnished by parties other than the fan manufacturer are unacceptable.
 - 1) The pressure transducer shall be provided with the equipment.
 - 2) The station shall be accurate within +/- 5% of reading at the design airflow rate, and throughout a 5 to 1 turndown range.
 - 3) No less than four (4) low pressure taps shall be provided for each fan inlet, with the average forming the low pressure signal to the transmitter / transducer. A single high pressure tap per fan inlet is acceptable.
 - 4) Station shall be constructed of nylon or copper tubing connected to aluminum or stainless steel pressure probes.

- 5) Transmitter: A transmitter with integral pressure transducer shall be provided. For fan arrays, provide a dedicated transmitter for each fan inlet station.
 - a) The transmitter shall be a dead-ended type, and shall maintain a linear output signal through a range of 10 to 1 velocity turndown.
 - b) The transmitter shall be available in multiple natural spans covering the range of 0.05 IN w.c. to 25.0 IN w.c. with an accuracy of 0.1% of natural span. Transmitter shall be an Air Monitor 'VELTRON-II', or approved equal.
 - c) The differential pressure transducers shall be selected so that the usable full scale of the device shall be no greater than 90% of the natural span.

B. Controlled Output Devices:

1. Control Dampers:

- a. The DDC Contractor shall furnish all automatic control dampers not specified to be supplied integral to the HVAC equipment. These field-applied dampers shall be installed by the Division 23 Contractor.
- b. Dampers shall be supplied with shaft / control rod extended to accommodate the specified operator. Only one control shaft per damper section. Only one actuator per damper shaft. Provide multiple damper sections mulled together when required to meet application requirements.
- c. Damper actuators shall not be installed inside ducts unless specifically indicated on the Drawings, or approved by the Architect / Engineer.
- d. Jackshaft Assemblies: Provide jackshafts for actuation, in lieu of using the damper's integral control rod, where required by the application, as recommended by the damper manufacturer. Jackshafts shall be TAMCO 'Horizontal Jackshaft' or 'Vertical Jackshaft', or approved equal.
 - 1) Frame mounting brackets (i.e. bridge and side brackets) for the jackshaft shall be mill finish extruded aluminum, minimum 0.125-inch thickness.
 - 2) Bearings: Minimum 1-inch inner diameter, maintenance-free, high-strength, abrasion and impact resistant thermoplastic polyamide. Sleeve bearings are not acceptable.
 - 3) Bearing Housings: Mill finish extruded aluminum, bolted directly to the frame mounting bracket.
 - 4) Blade Clips: Mill finish extruded aluminum and mounted directly to the drive blade. Formed blade clips are not acceptable.
 - 5) Jackshaft: Minimum 1-inch diameter extruded aluminum tubing. No more than one jackshaft per damper section.
 - 6) Crank arms, locking collars, and link bars shall be mill finish extruded aluminum. All non-aluminum parts are to be zinc-plated or galvanized steel.
 - 7) Jackshaft rotation shall be 90 degrees and shall allow for direct mounting of actuators with no additional connectors or drive rods required.
 - 8) Jackshafts shall be mounted directly over the drive blade in order to minimize length of the link bars.
 - 9) Jackshaft linkage shall have fixed arms and bearings located at pivot points. Swivels are not acceptable.

e. Shape Applications:

- 1) For dampers shown on rectangular ducts, provide multi-bladed rectangular dampers matching the duct size. Damper frames shall have integral flanges for duct connections on each side (i.e. in-duct frame types are not acceptable). For dampers with heights less than 12", a single blade damper may be provided.
- 2) For dampers shown on round ducts, unless the damper size / shape is explicitly identified, the Contractor shall provide a square damper with duct transitions (physical space and system pressure and velocity requirements all permitting).

f. Material Applications:

- 1) Provide aluminum or galvanized steel damper construction (blades, frames, axles, and linkages) in galvanized duct systems.
- 2) Provide aluminum dampers (aluminum blades, frames, axles, and linkages) in aluminum duct systems.
- 3) Provide Type 304 / 316 stainless steel dampers (stainless steel blades, frames, axles, and linkages) in stainless steel duct systems (e.g. dishwasher exhaust).
- 4) Refer to Division 23 Section "Ductwork" for duct construction materials specified.
- 5) Provide insulated dampers where indicated on the Drawings.

g. Rectangular Control Damper Blade Configuration:

- 1) All modulating / proportional dampers shall be opposed blade type.
 - a) Exception: Outdoor-air and return-air dampers as part of a mixed air arrangement shall be parallel blade.
- 2) Two-position dampers may be of the opposed or parallel blade type (Contractor's option).

h. Rectangular Control Dampers, Standard Construction:

- 1) Provide Standard Construction dampers where installed in galvanized steel ductwork, unless otherwise indicated.
- 2) Where indicated for installation in aluminum ductwork, provide damper with aluminum frames, blades, and axles.
- 3) Frames: Minimum 16 gauge galvanized steel structural hat channel with tabbed/reinforced corners. Extruded aluminum frames, minimum .080" thick, are also acceptable.
- 4) Blades: 14 gauge equivalent thickness galvanized steel. Blades shall be roll-formed airfoil type. Extruded 6000-series aluminum airfoil blades, minimum .060" thick, are also acceptable.
- 5) Blade Edge Seals: EPDM or extruded silicone suitable for -40°F to +212°F, mechanically locked into the blade edge. Adhesive or clip-on type seals are unacceptable.

- 6) Jamb seals: Flexible stainless steel, compression type to prevent leakage between blade end and damper frame. Blade end overlapping frame is unacceptable. EPDM or extruded silicone jamb seals are also acceptable in lieu of stainless steel.
- 7) Bearings: Corrosion resistant, permanently lubricated stainless steel sleeve or bronze oilite type turning in an extruded hole in the damper frame.
- 8) Axles: Minimum 7/16" cadmium plated steel or extruded aluminum. Hexagonal shape positively locked into the damper blade. Linkage shall be concealed out of air-stream, within the damper frame to reduce pressure drop and noise. Linkage bearings shall be stainless steel sleeve or bronze oilite.
- 9) Leakage Performance: Damper submittal shall include leakage, maximum airflow and maximum pressure ratings based on AMCA Publication 500. Dampers shall bear the AMCA 511 label for air leakage.
 - a) Damper shall leak less than 3 cfm/sq. ft. at 1" of static pressure as per AMCA 500 (Class 1A damper), up to 60" blade width.
- 10) Pressure Drop Performance: A 36" x 36" sized damper shall have no more than .06 inches w.g. static pressure drop at 2,000 fpm face velocity, fully open.
- 11) Pressure and Velocity Ratings: Damper construction shall be suitable for up to 7" w.g. static pressure differential and 3,000 fpm face velocity in blade lengths up to 36".

i. Rectangular Insulated Control Damper Construction:

- 1) Dampers shall be as described above for Standard Construction, except for the following:
 - a) Blades, frame, and axles shall be aluminum or stainless steel, or a combination thereof (i.e. galvanized steel is not acceptable).
 - b) The internal volume of the blades shall be filled with high density expanded foam insulation, and the blades shall have an R-value of no less than 2.3.
 - c) Frame shall be thermally broken with polyurethane resin pockets and thermal cuts. If the frame is not thermally broken, damper will still be acceptable if the damper has an AMCA Std. 500-D Thermal Efficiency Ratio of no less than 340%.

j. Subject to compliance with requirements, provide one of the following products:

- 1) Rectangular, Standard Construction:
 - a) Ruskin 'CD50' (aluminum) or 'CD60' (galv. steel)
 - b) TAMCO '1500 Series'
 - c) Arrow 'AFD-20'
 - d) Greenheck 'VCD-33' (galv. steel) or 'VCD-40' (aluminum)
 - e) Johnson Controls 'VD-1330' (aluminum) or 'VD-1630' (galv. steel)
 - f) Pottorff 'CD-51/52' (aluminum) or 'CD-45/46' (galv. Steel)

- 2) Rectangular, Insulated:
 - a) Ruskin 'CDTI-50'
 - b) TAMCO '9000 BF'
 - c) Greenheck 'ICD-45'
 - d) Pottorff 'TICD-52-BF'
 - e) Arrow 'AFDTI-25'

2. Electric Actuators: The actuators shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.

- a. For power-failure and safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable. All spring return actuators shall be capable of either clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
- b. Actuators shall be designed for a minimum of 65,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of Substantial Completion.
- c. Actuators shall be UL listed.
- d. Electric Damper Actuators: Provide one actuator per damper section / damper shaft. Multiple actuators installed on a given shaft (i.e. "tandem mounting") is not acceptable.

- 1) Rating: NEMA 1 or 2 enclosure where located indoors. NEMA 4X where located outdoors.
- 2) Mounting: Direct mount on the associated damper shaft.
- 3) Location: Outside the ductwork.
- 4) Minimum actuator resolution: 100:1
- 5) Maximum actuator hysteresis: 2%
- 6) Stroke Time: 90 seconds end to end full stroke, 15 seconds return to normal for spring return.
- 7) Protection: Electronic stall protection.
- 8) Control Input: 0-10 VDC or 0-20mA DC.
- 9) Power: Nominal 24 VAC.
- 10) Torque: Size for minimum 150% of required duty.
- 11) Duty Cycle: rated for 65,000 cycles.
- 12) Special: Output position feedback, manual override, field selectable rotational/spring return direction, field adjustable zero and span.
- 13) Warranty: Two years, unconditional.
- 14) Provide built-in auxiliary switch for interfacing or signaling.

- a) This switch shall not be utilized to provide position indication if an independent end switch device is required elsewhere by this Specification, or is indicated in the Sequences of Operation or on the Drawings.

e. Acceptable Manufacturers: Subject to compliance with requirements, provide actuators by one of the following manufacturers:

- 1) Belimo
- 2) Bray International
- 3) Honeywell
- 4) Johnson Controls Inc.
- 5) Schneider Electric
- 6) Siemens
- 7) IMI-TA

C. Miscellaneous Accessories:

1. Weather- and Sun-Shields: Provide for temperature sensors located outdoors shall prevent the sun from directly striking the sensor. The weathershield shall be provided with adequate ventilation so that the sensing element responds to the ambient conditions of the surroundings. The weathershield shall prevent rain from directly striking or dripping onto the sensor. Weathershields installed near or in outside air intake ducts shall be installed such that normal outside airflow does not cause rainwater to strike the sensor. Weathershields shall be constructed of unpainted aluminum or white PVC.
 - a. The shield shall be a BAPI 'Weather Shade' or approved equal.
2. Clear Anti-Tamper Thermostat Guard: Clear plastic hinged cover, with vented base and integral key lock. Guard shall be Honeywell 'TG5xxx' series, or approved equal.
3. Opaque Anti-Tamper Thermostat Guard: Painted off-white steel cover with vented plastic base and integral key lock. Guard shall be Honeywell 'TG5xxx' series, or approved equal.

2.20 CONTROL AND COMMUNICATION WIRING AND CABLES

- A. Electric control wiring shall be in accordance with the National Electrical Code and Divisions 26 and 27 of these specifications, and shall not be in conflict with state and local codes. No control wiring shall be installed in the building lighting and power circuit system.
- B. All conduit, fittings, hangers and accessories for control wiring installed under Division 23 shall conform to the levels of quality specified under Divisions 26 and 27.
- C. Control wiring operating at voltages higher than 30VAC shall be single conductor solid or stranded copper not less than No. 12 AWG, 90 degrees C., with 600 volt Type THHN/THWN insulation. Wiring in panel construction may be No. 16 or No. 18 AWG copper provided same is properly protected and/or is in accordance with the NEC.
- D. Low Voltage Cabling (30VAC and less): Twisted (six turns per foot) minimum 22 AWG wire, with 90 degrees C., 600 volt THHN/THWN insulation. Cable shall have a characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 17 pF per foot. The number of conductors (2, or 3 with a ground conductor) shall be as recommended by the ATC system manufacturer.

1. Shielded cable shall be provided for analog inputs, for communications between controllers, and for runs exceeding 500 feet. Both foil and braided type shields are acceptable. Ground at one end only; cap the other end. Capacitance between conductors and the shield shall be less than 60 pF per foot.
 2. Use 20 AWG in runs exceeding 500 feet, but not exceeding 1,000 feet.
 3. Use 18 AWG in runs exceeding 1,000 feet, but not exceeding 2,000 feet.
 4. Use 16 AWG in runs exceeding 2,000 feet. Maximum length permitted is 4,000 feet.
 5. Cable used on BACnet MS/TP networks shall be specifically designed and intended by the manufacturer to be used for RS-485 communication.
 6. Cable shall be as manufactured by Alpha Wire Company, Belden Wire Company, Standard Wire and Cable, or approved equal.
- E. Ethernet Cabling: Cat5e or Cat6, copper unshielded twisted pair (UTP), ETL verified to ANSI/TIA-568.2-D. Do not exceed 330 feet of cable length. Provide additional Ethernet switches or hubs to accommodate runs longer than 330 feet. Use solid conductors for runs longer than 50 feet. Conductor shall be min 24 AWG, except cabling to power-over-Ethernet (POE) devices shall utilize minimum 22 AWG conductors. Cable shall be as manufactured by Leviton (Berk-Tek), Belden, Commscope, or approved equal.
1. All DDC system cabling connecting to the Owner's LAN shall be in full compliance with the Owner's requirements. In the event of a conflict, between this Section and the Owner's Requirements, this Section shall NOT take precedence.
- F. Fire Rated Cables: Power and signal wiring located inside the building and routed between DDC system controllers that are UL864 listed for smoke control and life safety / fire alarm use and the associated field devices (e.g. sensors and controlled devices such as fans, dampers, etc.) shall utilize 2-hour fire rated mineral insulated cables that are UL listed as 'fire resistive alarm cables' and meet NFPA 70 & 72 fire alarm survivability circuit requirements. Route cables in metallic raceways meeting the UL listing requirements.
1. Exceptions: Cables that are routed:
 - a. In a 2-hour rated shaft wall enclosure or stairway enclosure.
 - b. Through a space dedicated to housing fire alarm devices and separated from the remainder of the building by 2hr rated fire barriers (e.g. high rise building fire command center).
 - c. Through metallic raceway and encased in no less than 2-inches of concrete on all sides.
 - d. In a UL listed electrical circuit protective system with a 2-hour fire rating.
 2. All wiring shall be in an enclosed raceway except that installed inside control panels.
- G. Fiber Optic Cable: Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.
1. Connectors: Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

2. All DDC system cabling connecting to the Owner's LAN shall be in full compliance with the Owner's requirements. In the event of a conflict, between this Section and the Owner's Requirements, this Section shall NOT take precedence.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct-, pipe-, and equipment-mounted devices and wiring are installed before proceeding with the balance of the control system installation.
- C. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect for resolution before starting rough-in work.
- D. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to the Architect for resolution before starting rough-in work.
- E. Examine the contract documents (Drawings and Specifications) for work of other suppliers and Divisions. Report inadequate headroom or space conditions or other discrepancies to Architect and obtain written instructions for changes necessary to accommodate the work of this Section with work of other Divisions or suppliers. The controls contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 DEMOLITION AND REUSE OF EXISTING MATERIALS AND EQUIPMENT

- A. The Contractor shall assume that existing equipment that is specifically indicated on the Drawings to be reused is in good condition and is operable. The Contractor during the course of work, shall inspect these devices and determine if any devices are in need of replacement or repair. The Contractor shall prepare an itemized list of suggested repairs/replacement. This repair/replacement will be at the discretion of the Owner and may be accomplished under separate contract, at the Owner's direction.
- B. Existing wire, conduit, and control panel cabinets may be reused at the Contractor's discretion, but only if such materials or equipment comply with the applicable specification for new materials and equipment. Such materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service. Materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service. The Owner does not guarantee the suitability of any such existing materials or equipment for reuse in accordance with the requirements for new materials and equipment.
- C. Where such materials are reused, the contractor's shop drawings shall reflect the existing wiring designation. If existing labeling is illegible or otherwise does not comply with the applicable specification for labeling, wiring runs shall be relabeled in accordance with the requirements specified elsewhere.

- D. Existing controllers and point expansion modules that are being replaced as part of this project shall be turned over to the Owner. All other existing control devices and panels that will not be reused shall be disposed of by the Contractor.
- E. Existing electrical service to control panels or devices that are indicated to be demolished or otherwise will not be reused shall be properly terminated and secured per NEC requirements. Label wire with the panel and circuit breaker it is served by. Label wire as "HOT" if circuit cannot be de-energized. If existing electrical circuits only provide power to demolished control panels or devices, then the circuit shall be removed in its entirety (conduit, wire, and supports) back to the originating panel board circuit breaker. Update the panel schedule to reflect the circuit breaker as a "spare".
- F. Existing pneumatic tubing located between the existing BAS panels and the pneumatic operators shall not be reused; however, conduit for such tubing may be reused. All other pneumatic tubing may be reused, but only if such materials comply with the applicable specification for new materials. Materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service.
- G. The existing pneumatic main air supply system shall be modified as required and reused to serve existing pneumatic controls that are to remain, and shall be extended as necessary to serve new pneumatic controls. Where existing pneumatic controls are being removed, main air piping shall be removed back to the point of connection to the main air supply which remains in use, and shall be capped or plugged.
- H. The Contractor shall clean and lubricate all damper linkages of control dampers being re-used under this Project.
- I. Other materials and equipment not specifically mentioned herein may be reused only if specifically allowed by indications on the Drawings.
- J. For existing pneumatically control HVAC systems which are indicated to receive new controls, all existing materials and equipment associated with the existing pneumatic system and BAS shall be removed unless otherwise specified or indicated to remain, or unless reused in accordance with the above requirements, except for the following:
 - 1. Conduit and electrical boxes (but not wiring within conduit) may remain in place if not reused;
 - 2. Inaccessible pneumatic tubing may remain in place if not reused.
- K. For systems with existing workstation graphics, the existing graphic shall be entirely removed from the system including all links and references and replaced with a new graphic meeting all requirements of the BAS specification Sections. If renovation is only partial, the entire system graphic shall be replaced including devices and equipment that will be reused.
- L. Existing system points shall be released. Partial system renovations shall not be split between old and new points. All points shall be created or recreated to meet the requirements of this Contract.
- M. Extend control power and communication wiring and conduit as required to accommodate the relocation or replacement of existing equipment or motor controllers, and as required to maintain existing equipment otherwise not affected by the scope of the project under full automatic control.

- N. Relocate existing control devices as required to accommodate the relocation of equipment, and as required to maintain existing equipment otherwise not affected by the scope of the project under full automatic control, unless new control devices are explicitly indicated.

3.3 INSTALLATION - GENERAL REQUIREMENTS

- A. Install equipment level and plumb.
- B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and connect and configure equipment and software as appropriate to achieve the sequence of operation.
- C. Do not install control equipment and devices inside airstreams (e.g. inside ducts or air handling equipment air tunnels) unless the proper functioning of the device or equipment demands such an installation, or the equipment/device manufacturer recommends or requires such an installation. Devices and equipment may be installed in above-ceiling spaces that are used as return air plenums.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all devices that have a manual adjustment or visual read out feature in accordance with ADA regulations, 48-inches above the floor, unless noted otherwise on the Drawings. Field coordinate with the work of other trades, and subsequently verify all proposed locations with the Architect prior to proceeding.
- E. Installations of controllers and input / output control devices outside the building shall be inside NEMA 3R enclosures. Factory devices with a housing of equivalent rating and intended by the manufacturer for exterior installations may be installed outside of enclosures.
 - 1. Wherever possible, install damper motors, duct mounted sensors, and similar devices on outside of duct in weather-protected and warm areas, not in locations exposed to weather and outdoor temperatures.
 - a. Where exterior damper actuator installation cannot be avoided, provide a NEMA 3R enclosure for mounting of the damper actuator, or provide an actuator with an equal or better NEMA rating.
- F. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC."
 - 1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings. Labels shall be provided within 3" of each wiring connection.
 - 2. Identify all pneumatic and instrumentation pressure signal tubing with a label within 3" of at each connection.
 - 3. All field enclosures, other than controllers, shall be identified with an equipment nameplate. The lettering shall be in white against cross-referenced with as-built drawings.
 - 4. Junction box covers shall be marked to indicate that they are a part of the DDC system.
 - 5. Provide engraved plastic laminate signage, in letters minimum 1/2-inch high, at all space fan start/stop momentary contact buttons, timing switches, etc. The signage shall indicate

the switch/system function. A red plate with white letters shall be used for emergency functions, and white with black letters shall be used for normal / non-emergency functions.

6. Label space thermostats, relative humidity sensors, carbon dioxide sensors, and similar space sensors with the name/designation/number of the associated HVAC equipment / air system. For devices controlling a VAV terminal, the name of the VAV terminal only shall be indicated.

G. Install warning labels as follows:

1. Affix permanent warning labels to equipment that can be automatically started by the control system.
 - a. Labels shall use white lettering (12-point type or larger) on a red background.
 - b. Warning labels shall read as follows.

C A U T I O N

This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

2. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
 - a. Labels shall use white lettering (12-point type or larger) on a red background.
 - b. Warning labels shall read as follows.

C A U T I O N

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

H. The Division 23 Contractor shall install:

1. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

I. Install control and interlock wiring according to applicable Division 26 Sections.

J. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. General: Provide a complete system of electric wiring for temperature control apparatus. In addition, provide 120 VAC power to terminal equipment controllers and various DDC panels, subpanels, damper actuators and valves if not specifically shown on contract drawings to be provided under Division 26. The ATC contractor shall be responsible for all electrical installation which is necessary to achieve a fully functional ATC system (and which may or may not be shown on the Electrical Drawings, or required by the Division 26 Electrical Specifications). All wiring shall also be in accordance with applicable local and national codes.

- B. Install control wire and cable, raceways, boxes, and cabinets according to applicable Sections of Division 26.
- C. Conceal cable and wire in panel enclosures and raceway.
 - 1. Raceway shall be concealed except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Exterior raceway shall be rigid, hot-dipped galvanized steel conduit.
 - 3. Interior raceway shall be EMT, IMC, or rigid galvanized steel conduit.
- D. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- E. BACnet MS/TP networks shall utilize a series / daisy chain topology, and shall comply with the RS-485 (EIA-485) standard.
- F. No temperature control wiring installed under this contract shall be installed in conduits for the building lighting and power circuit system.
- G. Connect safety switches and similar high and low limit controls independent of manual-control switch positions.
- H. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.5 FIBER OPTIC CABLE

- A. Fiber optic cable shall be installed in dedicated raceways.
 - 1. Exception: Fiber optics can be run with Ethernet and RS-485 cabling as long as the conduit is bent to fiber optic standards and junction boxes are sized for fiber optic use.
- B. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.
- C. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.6 SPECIFIC INSTALLATION PRACTICES

- A. Controls Systems Wiring:
 - 1. All conduit raceways, wiring, accessories and wiring connections required for the installation of the Controls Systems shall be provided by the DDC Contractor except as explicitly shown on the Electrical Trade documents. All wiring shall comply with the requirements of applicable portions of the Electrical Trade work and all local and national electric codes and the requirements of the AHJ.

2. All Controls Systems wiring materials and installation methods shall comply with the original equipment manufacturer recommendations and standards.
3. The sizing type and provision of cable, conduit, cable trays and raceways shall be the design responsibility of the DDC Contractor.
4. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
5. Class 2 signal wiring and 24VAC power may be run in the same conduit. Power wiring 120VAC and greater shall not share the same conduit with Class 2 signal wiring.
6. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:
 - a. All circuits are continuous and free from short circuits and grounds.
 - b. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megaohms.
 - c. All circuits are free from induced voltages.
7. Provide complete testing for all cables and wiring. Provide all equipment, tools, and personnel as necessary to conduct these tests.
8. Provide for complete grounding of all signal and communication cables, panels and equipment so as to ensure integrity of Controls Systems operation. Ground cabling and conduit at panel terminations. Do not create ground loops.
9. Each control wire termination at controllers / in control panels shall have wire-labels within 3" of each terminal connection. Wire labeling shall match the final as-built drawings.

B. Line Voltage Power Sources:

1. 120-volt AC circuits for the Controls Systems shall be taken by the DDC Contractor from electrical trade panelboards, circuit breakers, and/or junction boxes as designated on the Drawings.
2. Circuits used for the Controls Systems shall be dedicated to these Controls Systems and shall not be used for any other services.
3. DDC terminal unit controllers may use 120-volt AC power serving motor power circuits, but only upstream of the starter or VFD disconnect switch.
4. Provide disconnect switches at all points of 120V power connection to controllers and powered equipment.

C. Controls Systems Raceways:

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in the Specification. Minimum conduit size 3/4".
2. Where it is not possible to conceal raceways in finished locations on existing masonry or concrete walls, surface raceway (e.g. "Wiremold") may be used. The raceway shall be painted to match that of the adjacent surfaces.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the supporting surface.
4. UL/ULC Listed Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment supported or hung with external vibration isolation devices.

5. Provide sealing bushings where cables exit conduits / enclosed raceways, except at connections to control panel enclosures.

D. Penetrations:

1. General: Penetrations shall only be made with sleeves, conduits, and enclosed raceways. Bare cables shall not penetrate walls, floors, roofs, ceilings, duct walls, and equipment casings.
2. Architectural Penetrations:
 - a. Firestopping and smoke stopping for all penetrations used by dedicated controls system conduits and raceways shall be by the HVAC contractor.
 - b. All openings in fire- or smoke- rated elements shall be closed with approved fire resistive sealant or fire stopping sleeves. Refer to Division 07 and Division 23 Section "Common Work Results for HVAC".
 - c. Sleeves shall be used for penetrations through drywall and non-bearing partitions, where cables are otherwise permitted to be installed outside of conduit / enclosed raceway.
 - d. No penetrations through building structural elements, slabs, ceilings and load bearing walls shall be made before receipt of written approval from the Architect.
 - e. Control signal and control power conduit penetrations of the roof not made inside equipment curbs shall be made through pre-fabricated pipe portals or roof pipe chases, to provide a weathertight installation.
3. Conduit Penetrations of Ducts:
 - a. Do not drill holes larger than required for passage of conduit / enclosed raceway or sensing element.
 - b. Seal opening with rubber grommet, duct sealant, or rubber gasket-backed flange, as appropriate for the installation.
 - c. Do not make penetrations on the bottom of outdoor air intake ducts.
 - d. Do not install penetrate the top of exterior ducts with fasteners, devices, or raceway.
4. Penetrations of and Air Handling Equipment (e.g. AHUs, fan coils, RTUs, etc.) Casings:
 - a. Drill holes only where approved by the unit manufacturer and in compliance with the manufacturer's recommendations. Do not cut structural frame elements. Do not drill holes larger than required for passage of conduit / enclosed raceway. Holes shall not compromise the structural integrity of the casing.
 - b. Do not install penetrate the top / roof of exterior HVAC equipment with fasteners, devices, or raceway.
 - c. Paint raw edges of galvanized steel sheet with cold galvanized paint.
 - d. Penetrations that are not exposed to the weather shall be sealed with silicone sealant and finished over on both sides with a brass or stainless steel escutcheon. Sealant shall fill the annular space between the hole and the conduit, filling the entire depth.
 - 1) Tight fitting spool-shaped rubber grommets are also acceptable. Apply sealant around the hole, behind the lip of the grommet, on both sides of the penetration.

- e. All exterior conduit penetrations in the housing and internal conduit penetrations across the cooling coil sections and humidifier sections, and all sections downstream of the cooling coil and humidifier sections shall be internally sealed with foam sealant to prevent the migration of water vapor in the conduit.
- f. Penetrations that are exposed to the weather shall be made with CSI Designs "Pipetite" seals.
- g. Control cable inside equipment shall be routed in conduit or other enclosed raceway.

E. Controls Systems Identification Standards:

- 1. Controller and Control Panel Identification: All individual controllers and control panels shall be identified by a permanent label fastened to the outside of the enclosure. Labels shall be suitable for the panel's environmental location.
- 2. Cable shall be labeled at every termination with cross-referencing to record documentation.
- 3. Raceway Identification: Exposed covers to junction and pull boxes of the raceways shall be identified at primary points.
- 4. Wire Identification: All low and line voltage wiring shall be identified by a number, as referenced to the associated shop and record drawing, at each termination.
- 5. Wires and cabling shall not be spliced between terminations. Cable shields shall be single end grounded - typically at the panel end outside the panel.

F. Field Panel and Device Installations And Locations:

- 1. The Controls Systems panels, enclosures and cabinets shall be located as coordinated with the Architect at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
- 2. All field devices shall be installed per the manufacturer recommendation and in accessible locations as coordinated with the Architect.
- 3. Panels shall not be installed in exposed, finished areas of the building unless specifically indicated on the Drawings. Locate indoor panels in unfinished rooms and above accessible ceilings.
- 4. Do not install panels inside airstreams (e.g. inside ducts or air handling equipment air tunnels). Panels may be installed in above-ceiling spaces that are used as return air plenums.
- 5. Panels to be located in damp areas or areas subject to condensation shall be mounted with wall standoffs.
- 6. Conduit configurations entering or leaving panels and devices shall be such as to preclude condensation traps.

G. Input / Output Control Device Specific Installation Requirements:

- 1. Airflow Measuring Stations (AFMSs):
 - a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
 - b. Install sensors in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.
 - c. Each airflow station application shall be examined by the AFMS supplier and the AFMSs shall be applied such that the specified accuracy is achieved. The specified accuracy requirement shall apply to the entire operating range of the equipment

associated with the AFMS. These conditions shall be met when the AFMSs are applied according to the manufacturer's guidelines. This application shall be done based on actual field conditions (through the process of generating ductwork shop drawings and coordination drawings) and not Contract Documents. Any station not complying with the manufacturer's installation guidelines shall be so noted in the submittal process. The submittals for the AFMSs shall include tag, range, output, size, product accuracy, installed system accuracy, sensor density, installation type, and all other relevant data to access the AFMSs and their performance.

- d. After airflow measuring stations have been fully installed in accordance with the manufacturer's recommendations, perform a flow measurement verification with the assistance of the Testing, Adjusting, and Balancing (TAB) Agent performing the work of Division 23 Section "Testing, Adjusting, and Balancing for HVAC". Refer to that Section for additional information.

- 1) Where recommended by the airflow station manufacturer for the installed condition, or requested by the Architect / Engineer, perform a field calibration of the station with the assistance of the Testing, Adjusting, and Balancing Agent.

- e. Installed airflow stations shall be accessible for visual inspection and service. Install access doors in duct or equipment located both upstream and downstream of sensor, to allow service personnel to inspect and hand clean the stations.
- f. An identification label shall be placed on each station listing the model number; system served, size and identifying tag number.
- g. Differential Pressure Based Airflow Measuring Density Correction: The DDC system shall employ an air density correction factor to the airflow rate calculation performed for converting differential pressure signals from pitot tube and piezo ring stations to airflow values. Provide an analog input temperature sensor in the airstream for purposes of providing this active density correction.

2. Pressure and Differential Pressure Sensors and Switches:

- a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
- b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
- c. The transmitters shall be installed in an accessible location.
- d. Install pressure-sensor needle valve and snubber in piping to pressure gages.
- e. Provide syphons and needle valves on piping to steam pressure sensors.

3. Indoor-Outdoor Differential Air Pressure Applications:

- a. The transmitter's exterior (low pressure) port shall be piped through a high volume accumulator and terminated with a shielded static air probe to reduce pressure fluctuations caused by wind. Pipe high-pressure port to a location behind a thermostat cover.
- b. The interior tip shall be located in an inconspicuous location approved by the Architect/Engineer prior to installation.

4. Exterior Duct, Plenum and AHU Differential Air Pressure Applications:
 - a. The transmitter's exterior (reference) port shall be piped through a high volume accumulator and terminated with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b. Provide the duct, plenum, or AHU pressure port all with static pressure tips, tubing, fittings and air filter.
5. Indoor Duct and AHU Air Differential Pressure Sensors and Status Switches:
 - a. Install with static pressure tips, tubing, fittings and air filter.
6. Medium to High Differential Air Pressure Applications (Over 10" w.g.):
 - a. In addition to other requirements specified above, provide air bleed units, bypass valves, and compression fittings.
7. Outdoor Air Temperature Sensors:
 - a. Sensors shall be mounted on a wall selected to minimize solar radiant heat impact or be located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b. Sensors shall be installed with a weather shield.
 - c. Sensors shall be mounted on the North wall (and provided with a weather / sun shield) to minimize solar radiant heat impact or located in continuous intake airflow adequate to monitor outside air conditions accurately.
 - d. Do not locate sensors near exhaust or relief air discharges. Maintain minimum 20 foot separation.
 - e. Do not locate above doors or operable windows.
 - f. Locate a minimum of 10 feet above adjacent finished grade and roof surfaces.
8. Duct and Plenum Temperature Sensors:
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. Use averaging type sensors in ductwork greater in any dimension than 48 inches, where air temperature stratification exists (such as a mixed air plenum), immediately downstream of an air blender, and immediately downstream of any heat exchanging element (coil, furnace, energy recovery heat exchanger, etc.)
 - d. Install averaging elements in ducts and plenums in a zigzag pattern, with evenly spaced passes. When horizontal stratification is anticipated, the pattern of passes shall be a vertical zigzag. When vertical stratification is anticipated, the pattern shall be a horizontal zigzag. When the stratification is unknown or complex, the element passes shall be set at approximately a 45 degree angle. Element length shall be sufficient such that each square foot of flow area of the duct, plenum, cabinet /air tunnel, or associated coil is provided with no less than 1 linear foot of sensing element. Provide multiple sensors as required.

- e. The sensor shall be mounted to suitable supports using factory approved element holders.
 - f. Support each bend in capillary with approved safe radius clips. Clips shall be non-metallic. Dwyer series 'CC1' or approved equal.
9. Low Temperature Limit Switches (Freezestats):
- a. Install on the discharge side of the first water coil in the air stream, or as indicated on the Drawings or in the sequences of operation.
 - b. Mount element horizontally across duct in a uniform, horizontal serpentine pattern insuring each square foot of coil is protected by no less than 1 linear foot of sensing element. Provide as many freezestats as required for full coverage.
 - c. Element shall be exposed to all areas that encounter low temperature, including along the bottom of the coil(s), from end to end.
 - d. Mount freezestats across the coil face in accordance with manufacturers recommended installation procedures. Do not kink or compress the sensing tube. Ensure that there are no sharp bends in the element and there are no kinks in the capillary tube. Tubes that are kinked shall require the freezestat to be discarded and replaced.
 - e. Support bends in the capillary element with approved safe-radius clips. Clips shall be non-metallic. Dwyer series 'CC1' or approved equal.
 - f. Provide intermediate supports to prevent excessive vibration of the element, or contact with other items.
 - g. Install a rubber grommet or bushing where the sensing element passes through sheet metal openings to both seal the opening and protect element from vibrational wear on the opening.
 - h. Allow unrestrictive access to the manual reset button, and label the device.
10. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke.
- a. Damper actuators shall not be installed inside ducts unless specifically indicated on the Drawings, or approved by the Architect / Engineer.
11. Space Thermostats and Temperature Sensors: Room thermostats and temperature sensors shall be installed at locations indicated on the Drawings, however the control manufacturer shall carefully check the Architectural and Electrical Drawings to verify the locations indicated. Any relocation of room thermostats to avoid conflict with other trades or at the control manufacturer's recommendation to improve performance, shall be only as approved by the Architect.
12. Space Control Device Guards: Room temperature sensors, thermostats, humidity sensors, space CO2 sensors, and similar wall mounted control devices located in toilet rooms, corridors, lobbies, and where indicated on the Drawings shall be protected with guards securely anchored to the wall.
- a. Clear plastic anti-tamper type shall be used except as noted otherwise.

3.7 COORDINATION WITH THE TESTING ADJUSTING AND BALANCING AGENT

- A. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures requiring manipulation of DDC system control parameters.
- B. Coordinate with the TAB Agent / sub-contractor and with the Commissioning Agent to fine tune control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB contractor, and note any TAB deficiencies in writing:
 - 1. Optimum duct static pressure setpoints for VAV air handling units.
 - 2. Minimum outside air damper settings for constant volume air handling units.
 - 3. Optimum differential pressure setpoints for variable speed pumping systems.
 - 4. Calibration parameters for flow control devices such as VAV boxes / air valves and duct and piping flow measuring stations/ meters.
- C. Assist the TAB Agent in performing testing and balancing of variable volume air and hydronic distribution systems, and testing of such systems that have flow diversity by manipulating air and water flow at each control terminal or valve through the DDC system, as directed by the TAB Agent.
- D. Airflow Control Terminals: BAS Contractor shall provide a hand held device as a minimum to the TAB Agent to facilitate airflow control terminal (e.g. VAV box) calibration. Connection for any given device shall be local to it (i.e. at the VAV box or at the thermostat). Portable operator's terminal shall allow querying and editing of parameters required for proper calibration and start up.
 - 1. Train the Testing and Balancing Agent to use control system interface tools.
 - 2. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.

3.8 COORDINATION WITH THE COMMISSIONING AGENT

- A. A Commissioning Agent will be engaged for formal commissioning and system certification at the completion of construction. The DDC sub-contractor shall assist the Commissioning Agent by supporting tasks as directed by the Agent. Refer to Section 23xxxx, HVAC Systems Commissioning.
- B. The required support and assistance shall generally include the following:
 - 1. Attend Commissioning (Cx) progress and coordination meetings.
 - 2. Prepare and submit required draft forms and systems information.
 - 3. Establish trend logs of system operation as specified herein.
 - 4. Demonstrate system operation.
 - 5. Manipulate systems and equipment to facilitate testing.
 - 6. Provide instrumentation necessary for verification and performance testing.
 - 7. Manipulate control systems to facilitate verification and performance testing.
- C. The DDC system provider shall perform their own functional testing and commissioning of the systems as elsewhere detailed in this Section (Article below titled "Commissioning of the Control System by the DDC System Supplier / Sub-Contractor") to verify that the systems operate in full

accordance with the sequences of operation prior to testing, adjusting, and balancing work, and prior to the start of work by the Commissioning Agent. Furthermore, the graphic equipment control diagrams on the Operator's Workstation shall be complete before the start of commissioning by the Commissioning Agent.

1. Compensation for Re-Testing: Compensate the Owner for site time necessitated by incompleteness of systems or equipment at time of functional performance testing. All testing failures which require on-site time for re-testing shall be considered actual damages to the Owner. The contract sum shall be reduced by contract modification at a rate of \$180 per person-hour of on-site time necessary to retest failures. All parties under contract with the Owner who are affected by the re-testing shall be included in the contract modification.

3.9 COMMISSIONING OF THE CONTROL SYSTEM BY THE DDC SYSTEM SUPPLIER / SUB-CONTRACTOR

- A. All testing and demonstration services described in this Article are in addition to any testing and demonstration requirements specified in Commissioning Sections.
- B. Commissioning of the system shall be complete before acceptance by the Owner.
- C. Pre-Testing Quality Control: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest. Verify the following:
 1. Verify operation of human machine interface.
 2. Verify local control units including self-diagnostics.
 3. Verify that the specified I/O capacity has been provided.
 4. Verify that DDC controller power supply is from emergency power supply, where applicable.
 5. Verify that wires at control panels are tagged with their service designation matching that shown on the shop drawings.
 6. Check control valves. Verify that they are piped with the flow in correct direction.
 7. Check dampers to verify proper blade arrangement, either parallel or opposed, has been provided, and that the dampers fully close and open.
- D. General Testing Procedures: Each phase of testing shall be completed and accepted before proceeding to the next step of testing. It shall be the responsibility of the DDC system supplier to coordinate and schedule the required trades and technicians required to complete testing. Project completion delays caused by inadequate coordination and scheduling or delays caused by failure to meet these commissioning specifications shall be the responsibility of this Contractor.
 1. Test plans shall be developed for each phase of testing by the DDC system supplier and shall define all the tests required to ensure that the system meets all requirements of the Contract Documents. The test plans shall define milestones for the tests; identifying simulation programs, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.
 2. Test reports shall be used to document the results of each test.

3. Testing shall be performed in two basic phases:
 - a. Phase One - General Performance Testing verifies the accuracy of the sensors and end devices and general system operation, flexibility and response.
 - 1) Written permission shall be obtained from the Owner that this phase of testing has been successfully completed with the proper documentation before proceeding with the next phase of testing.
 - b. Phase Two - Functional Testing is operational sequence testing which verifies the proper operation of control strategies to match the sequence of operation.
- E. Phase One Testing - General Performance Testing: Calibration of each instrumentation device connected to the DDC system shall be performed by making a comparison between the reading at the respective device and the display at the supervisory HMI using a standard which is traceable to the National Bureau of Standards and shall be at least twice as accurate as the device to be calibrated.
1. All input devices (flow measuring stations, sensors / transducers, etc.) shall be tested to verify that they meet the accuracy as specified.
 - a. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
 - b. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
 - c. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
 - d. Provide diagnostic and test equipment for calibration and adjustment.
 - e. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
 - f. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
 - g. If, after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.
 - h. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements of the device manufacturer, and to supplement requirements indicated.
 2. The Phase One General Performance Tests shall be used to demonstrate the specified overall system performance and accuracy of the DDC system. System performance shall be verified on all systems on the specified failure modes upon DDC system failure or loss of power, and that all systems return to DDC system control automatically upon resumption of DDC system operation or return of power. Exercises shall be performed on the system according to the written test procedures in order to verify response time of all system activities (i.e., control loop response, alarm response, updating of temperatures, and other values). This testing shall also include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

- a. Network:
 - 1) Controller to controller data transfer time.
 - 2) Supervisory console to controller transfer time.
 - 3) Network reconfiguration.
 - 4) Network error recovery.

- b. System Controller and HMI:
 - 1) Scan rate.
 - 2) Analog input/output accuracy.
 - 3) Battery back-up duration.
 - 4) Screen refresh rate.

- c. Sensors:
 - 1) Visually inspect for proper installation and electrical connections.
 - 2) If the process variable can be simulated, input 0% range value and record the measured process variable, device output and displayed value at the DDC system terminal. Repeat this process for 50% and 100% of the process variable range.
 - 3) If the process variable cannot be simulated, use the ambient value for the process variable and record the measured process variable, device output and displayed value at the DDC system terminal. Simulate the device output signal current/voltage for 0% and 100% of the process variable range and record the measured device output signal and the displayed value at the DDC system terminal.

- d. Transducers:
 - 1) Visually inspect for proper installation and electrical connections.
 - 2) Enter 0% range value at the DDC system terminal and measure and record the device's input and output signal values. Repeat for 50% and 100% of device's range.

- e. Control Valves and Dampers:
 - 1) Visually inspect for proper installation and electrical connections.
 - 2) Enter 0% range value at the DDC system terminal and measure and record the device's input and output signal values. Repeat for 50% and 100% of device's range.
 - 3) Step the final element from 0% to 100% range value at the DDC system terminal and measure and record the device's 0% to 100% speed. Repeat for 100% to 0% of device's range.

- f. Miscellaneous:
 - 1) Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.

- 2) Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
 - 3) Check each alarm with an appropriate signal at a value that will trip the alarm.
 - 4) Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - 5) Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.
3. Documentation: Prepare a report documenting results. Include a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
- F. Phase Two Testing - Operational Sequence / Functional Testing: Operational sequence testing shall be performed to verify compliance of the completed DDC system with the Contract Documents. Using approved test procedures, all physical and functional requirements of the project shall be tested. Provide and schedule operational testing for each season (winter, summer, etc.) applicable to specific control sequence.
1. Phase Two - Operational Sequence / Functional Testing as specified shall not be started until after successful completion of the Phase 1 - General Performance Testing as specified above and submission of the Phase 1 report.
 2. Phase Two testing for systems and equipment that incorporate factory mounted and packaged controls shall involve the participation of the Installing Contractor, representatives of the equipment supplier or manufacturer, and the DDC system provider. Refer to other Division 23 specifications for the equipment and related systems requiring this form of cooperative testing effort.
 3. The Architect / Engineer and Commissioning Agent reserve the right to observe Phase 2 testing. Notify these parties no less than 7 days before testing begins.
 4. Testing procedures shall include the following:
 - a. Simulate and observe each individual control loop during each applicable operational mode by overriding and varying inputs and schedules.
 - b. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Where auto-tuning software is used record the final operating parameters. Auto-tuning software shall not be allowed to continuously adjust parameters as this may lead to masking other device or system problems. Record tuning parameters and response test results for each control loop.
 - 1) Obtain graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Perform further tuning of each loop that displays unreasonably under- or over-damped control.
 - c. Test the building fire alarm system interface.

- d. Test demand limiting modes of operation by obtaining trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
- 5. Documentation: Submit a report of testing results with trend data where appropriate. An operational test verification form shall be completed for each control loop. Any deviations or unsatisfactory results shall be noted in the remarks and signed and dated by the DDC system supplier's field engineer.
- G. Functional Performance Demonstration: At the request of the Architect / Engineer or the, Commissioning Agent, the DDC system provider shall provide a demonstration of the system performance. During this demonstration, the DDC system provider shall demonstrate actual field operation of each sequence of operation of each system in a manner similar to the Functional Performance Testing specified above. Provide at least two persons equipped with two-way communication. Demonstrate response of any input and output points requested by the Architect / Engineer or Commissioning Agent. Provide and operate test equipment required to prove proper system operation. Verify calibration of field devices where requested.

3.10 SOFTWARE OPTIMIZATION ASSISTANCE

- A. The BAS Contractor shall provide the services of a controls technician as specified above at the project site to be at the disposal of the Owner Architect/Engineer, and Commissioning Agent. The purpose of this requirement is to make changes, enhancements and additions to control unit and/or workstation software and sequence of operation that have been identified by during the commissioning of the project or during the warranty period that are beyond the specific requirements of the contract documents.
- B. The cost for a total of 16 hours of this service shall be included with the bid. The allotted hours may occur over as many as four (4) separate service calls. Unused training hours shall be used for additional software optimization assistance, at the Owner's request.
- C. The controls technician provided shall be thoroughly trained in the programming and operation of the controller and workstation software. If the controls technician provided cannot perform every software task requested in a timely fashion, contractor shall provide additional qualified personnel at the project site with deduction from the allotted hours of service.

3.11 OWNER DEMONSTRATION AND TRAINING

- A. The Controls Contactor shall provide the following training services for the Owner's key personnel at common sessions.
 - 1. Training shall not be less than a total of 8 hours, spread out over as many as 2 days (4 hours per day). Unused software optimization assistance hours shall be used for additional training, at the Owner's request.
 - 2. Specific schedules shall be established at the convenience of the Owner. The classes may be spread out during the Warranty Period as per the Owner's wishes.
 - 3. Training shall not begin prior to system commissioning and acceptance by the Owner.

4. This training shall be conducted by Field Engineer who is fully knowledgeable of the specific installation details of the Project.
- B. Prior to beginning training, conduct a walk-through of the Project to identify panel and device locations.
 - C. The training program(s) shall be designated to provide a comprehensive understanding and basic level of competence with the system. It shall be sufficiently detailed to allow customer personnel to operate the system independent of any outside assistant. The training shall be completed on the actual installed direct digital control system.
 - D. Online context sensitive HELP screens shall be incorporated into the system to further facilitate training and operation.
 - E. The training plan shall include detailed session outlines and related reference materials. The customer personnel shall be able to utilize these materials in the subsequent training of their co-workers.
 - F. Training sessions shall enable students to accomplish the following objectives, at the minimum.
 1. Understand the Project 'as-built' documentation.
 2. Understand naming conventions.
 3. Proficiently operate system.
 4. Understand control system architecture and configuration.
 5. Understand DDC system components.
 6. Understand system operation, including DDC system control and optimizing routines (algorithms)
 7. Operate workstation and peripherals.
 8. Log on and off system.
 9. Access graphics, point reports, and logs.
 10. Adjust and change system setpoints, time schedules, and holiday schedules.
 11. Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools.
 12. Understand system drawings and Operation and Maintenance manual.
 13. Understand job layout and location of control components.
 14. Access data from DDC controllers.
 15. Operate portable operator's terminals.
 16. Create and change system graphics.
 17. Create, delete, and modify alarms, including configuring alarm reactions.
 18. Create, delete, and modify point trend logs (graphs) and multi-point trend graphs.
 19. Configure and run reports.
 20. Add, remove, and modify system's physical points.
 21. Create, modify, and delete application programming.
 22. Add operator interface stations.
 23. Add a new controller to the system.
 24. Download firmware and advanced applications programming to a controller.
 25. Configure and calibrate I/O points.
 26. Interface with job-specific, third-party operator software.
 27. Maintain software and prepare backups.
 28. Understand system cybersecurity features and functions.

29. Understand procedures for software updates and applying security patches.
30. Add new users and set access restrictions.
31. Understand password security procedures, including 2-factor authentication.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices, system performance, commissioning, and submittal requirements.
 - 2. Other Division 23 Sections for factory mounted controls and communication interface gateways and DDC System Sub-Contractor led commissioning for equipment with factory controls packages.

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Throughout this specification, any reference to "DDC Contractor", "ATC Contractor or Subcontractor", "BMS Contractor", "BAS Contractor", "Control Contractor", "installer", "supplier", "Manufacturer" or "local field office" shall be interpreted as referring to the automatic temperature control system supplier/installer performing the work of Division 23 Section "Instrumentation and Control for HVAC".
- C. Where the term 'workstation' is used, it shall mean all means of human-machine interface with the DDC system.
- D. Refer to the Drawings for locations of some control devices, and for quantities of equipment and systems.

1.3 QUALITY ASSURANCE

- A. Code Compliance: All HVAC controls shall be programmed in order to meet all requirements articulated in ASHRAE 90.1- 2013 and the 2015 International Energy Conservation Code.
- B. Site Specific Application Programming and Qualifying Programming Experience: The programming shall meet the functional intent of the sequences of operation included in the contract documents. These sequences are intended to be performance based. Implementations that provide the same functional result using different underlying detailed logic will be acceptable. It is not acceptable for the BAS Contractor to merely provide typical or 'canned' software programs without thorough comparison to the contract document sequences of operation, and resulting modification as required. While the BAS Contractor is encouraged to

utilize control programming that has been thoroughly tested and successfully implemented on past projects, where the control applications are very similar to this project, the BAS Contractor is still obligated to make project specific modifications as required, and to identify discrepancies between the Contractor's proposed sequence and those in the contract documents. Similarly, the BAS Contractor shall evaluate the suitability of the contract document sequences of operation for implementation on this project. It is the BAS Contractor's responsibility to request clarification on sequence issues and questions that require such clarification, and to request approval for deviations from the contract document sequences of operation. All site specific programming shall be fully documented and submitted for review and approval, both prior to downloading into the panel, at the completion of functional performance testing, and at the end of the warranty period.

1.4 GENERAL SEQUENCE OF OPERATION REQUIREMENTS

- A. Refer to the Article titled "General System Requirements" in Division 23 Section "Instrumentation and Control for HVAC" for additional, general system requirements
- B. Scope: All control functions described in the sequences of operation shall be performed by the DDC system unless explicitly indicated otherwise. All work described shall be provided by the ATC system supplier/sub-contractor under the automatic temperature controls specification section unless explicitly indicated otherwise.
 - 1. In addition to meeting the requirements of the specifications, the DDC system sub-contractor is required to provide a particular control point if that control point is indicated in any one of the three possible control work representations that are part of these contract drawings. These three representations are the entirety of the HVAC drawings the control sequences of operation, and the control diagrams on the HVAC drawings (when a diagram has been prepared for a given system or type of equipment). The omission of a particular control point from one or more of these three representations shall not be construed to mean this particular control point is not required if it is indicated in one of these representations. Inclusion of the point in any one of the representations obligates the Contractor to provide the point as part of the complete and functional control system.
- C. Control Loops:
 - 1. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup.
 - 2. When a control loop is enabled or re-enabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a neutral value. The control loop in neutral shall correspond to a condition that applies the minimum control effect, i.e., valves/dampers closed, VFDs at minimum speed, etc.
 - 3. The term "control loop" or "loop" is used generically for all control loops. These shall typically be PID loops, but proportional plus integral plus derivative gains are not required on all loops. Unless specifically indicated otherwise, the following guidelines shall be followed:
 - a. Use proportional only (P-only) loops for limiting loops (such as zone CO2 control loops, etc.).

- b. Do not use the derivative (D) term on any loops unless field tuning is not possible without it.
 - 4. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change, with a default of 25% per minute.
- D. System Graphics: For each system or each piece of controlled equipment, display all points described in the sequences of operation or indicated in a control diagram on the Drawings (when applicable), as well as all operating modes, setpoints, high limit settings, time out periods, run times, temperature and pressure reset schedules, and active alarm conditions. Graphics of equipment and systems shall reflect the 'as-built' condition (i.e. do not use generic graphics). Locate all instruments and control objects as actually installed in the completed building. The graphics shall be no less detailed than the control diagram on the Drawings (where a diagram has been prepared for given system or type of equipment).
 - 1. Hardwired Points: System graphics shall display all system points associated with physical / hard-wired input and output devices (e.g. temperature and pressure sensors, safety switches, valves, dampers, points to VFDs and magnetic motor starters, etc.)
 - 2. Gateway Interfaces: System graphics shall incorporate all 'communication' points available through integration gateways provided with packaged equipment controls, air and water flow meters, and other devices provided with such communications gateways. Extend the appropriate / required portion of the DDC system network and connect to all such gateways. All gateway communication points shall be displayed on the system graphics on a separate page, linked from the main system graphic that shows all hard wired points. Communication points selected by the Architect / Engineer or the Owner shall also be displayed on the main system graphic.
 - 3. Additional Specific Requirements:
 - a. Dampers and Valves: Clearly identify the commanded position of each actuator position as % open or % closed. Actuator feedback shall be shown on the graphic, included the status of related end switches.
 - b. Air Handling Units and Similar Systems:
 - 1) Display the current outdoor temperature and humidity conditions.
 - 2) Clearly identify and provide navigation links to the graphics of all equipment or systems serving utilities to the air system.
 - 3) Display the current value and current control setpoint of all utilities served to the air system. Use the closest upstream sensor if a local sensor is not in the scope of work.
 - 4) Display the current operating mode of the air system. (e.g. Heating, Cooling, Warm-up, Economizer, etc.)
 - 5) Show all process variables and setpoints related to the discharge of the air system (pressures, flow rates, temperatures, humidity, dewpoint, etc.)
- E. Adjustable Values: All setpoints, thresholds, differentials, time delays, reset schedules, etc. indicated in the sequences of operation are initial recommendations only and shall be adjustable by the building operator at the DDC workstations or web browser via system graphics without re-programming (i.e. no alteration of system program code shall be required), assuming the user has the required access level.

1. All adjustable values shall be determined and/or verified during the DDC system commissioning process performed by the DDC system sub-contractor.
 2. Software points shall be used for all such adjustable values. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.
- F. VFD Points: Control points for variable frequency drives (VFDs) shall generally be obtained via communications between the VFD and the DDC system, however start / stop commands, speed command, drive run status, and alarm status points shall be hardwired. Coordinate with the VFD supplier the communications network card required to be furnished with the VFD. Unless additional points are indicated in the sequence of operation, or detail on the Drawings, provide the following minimum points through communications:
1. AI - Speed Reference / Feedback
 2. AI - Drive KW
 3. Run Time Totalization (hrs.)
 4. Drive Fault and Warning Details / Messaging
 5. AI - DC Bus Voltage
- G. Motor Controls:
1. Wire DDC system contacts for start/stop control over 3-phase motors to the magnetic motor starters provided by Division 26. Refer to the Electrical Drawings for locations of magnetic motor starters.
 2. The DDC system supplier shall provide line voltage control relays for automatic on-off control of single-phase motors. Locate relays near to the associated motor, and coordinate power wiring with the Division 26 Contractor. The DDC system supplier shall make power and control wiring terminations at the relay in accordance with applicable Division 26 provisions.
 3. Electrically Commutated (EC) Motors: EC motors serving fans and pumps indicated in the sequence of operation to have on-off and/or speed control shall receive an external binary and/or analog signal for this purpose. Note that for many EC motors, a zero (0) - VDC or -mA analog speed control signal is used to automatically de-energize the motor. Coordinate signal type requirements with the equipment supplier.
- H. Communication Gateway Connections: Extend the appropriate / required portion of the DDC system network and connect to all packaged equipment controls, air and water flow meters, and other devices provided with communications gateways.
- I. Factory Control Packages: Where equipment is specified in Division 23 with a factory control package, the DDC system sub-contractor shall be responsible for powering the unit controls (if not powered from the equipment's power connection), mapping points into the DDC system workstation when specified with a communication gateway, making control setting adjustments for proper operation with the assistance of the equipment factory's representative, commissioning and functionally testing the factory controls, and installing and wiring any field mounted control devices shipped loose and/or not factory wired.
- J. Units: All temperatures indicated in the sequences are in degrees Fahrenheit (deg. F.). Units of pressure are in inches water gauge (in. w.g.)

- K. Manual Overrides: The DDC system operator shall have the ability to override the speed, position, or operational status of all fans, dampers, pumps, and control valves via override command at the operator's workstation, including at the graphics, the I/O points list, and control logic pages. Any points manually commanded by an operator shall be clearly labeled and shall be reflected at all locations where manual commands can be executed. Values on the graphics shall also reflect any operator manual commands.
1. Exceptions: Systems and equipment that perform a safety function shall not be capable of being overridden off or into a mode or position that would reduce the safety of the building. This includes, but is not limited to, lab exhaust fans, grease hood exhaust fans, refrigerant exhaust fans, smoke exhaust fans, stairway or elevator shaft pressurization, fans, and fans dedicated to ventilating fire pump rooms and fire command rooms.
- L. Trends: All inputs, outputs, and calculated points of the DDC system shall be capable of being trended. The DDC system provider shall establish trends for any points the Owner deems necessary. Trends shall be initially set for a sampling rate of once every 5 minutes for each point or as required by the Owner. Trends shall be maintained for a minimum of seven days for all terminal equipment unless required otherwise by the Owner. Viewing of trend graphs shall be available at the DDC workstations or via the web browser. DDC controllers, panels and workstations shall be selected with adequate memory and storage capacity. The workstation shall issue an alarm and provide the user opportunity to save trend data to files prior to erasure of that data. Auto-save features shall be incorporated into the system to retain user-selected trend data without requiring continual user input.
- M. Unless explicitly specified otherwise elsewhere, all modulating dampers and valves shall be proportioning. The use of tristate outputs (two coordinated digital outputs) for floating control of is not permitted.
- N. Damper and Valve Fail Positions: Unless explicitly specified otherwise elsewhere, all damper and valve actuators shall have spring return mechanisms (except where explicitly noted otherwise, and for 8" valves and larger, which do not require spring return). Unless explicitly indicated otherwise in the sequence of operation or on the Drawings, dampers and valves shall be configured for the following spring return fail positions.
1. Outdoor air damper - Fail closed
 2. Relief air damper - Fail closed
 3. Return air damper - Fail open
 4. Exhaust fan dampers - Fail closed
- O. End Switches: End switches, where required by the sequences of operation, shall be a device that verifies the physical position of the damper. The use of auxiliary contacts on the actuator to indicate position is not acceptable. End switches shall be used to provide a "digital (binary) input" to the DDC system.
1. In addition to those indicated in the Sequences of Operation, provide an end switch to confirm the fully closed status of all dampers at intake and relief /exhaust louvers, gravity ventilators, and similar locations where the damper maintains continuity of the exterior building envelope when the associated air handling apparatus is de-energized or the damper is commanded closed. The DDC system shall issue an alarm when the damper fails to fully close.

- P. Damper and Valve Positions: Knowledge of damper and valve position are required for implementation of trim-and-respond type reset control loops, such as variable speed pump and fan remove differential pressure setpoint reset control. The following are acceptable methods for determining valve and damper positions:
1. Analog / Proportioning Actuators: Valve or damper position may be assumed to be equal to analog signal to actuator.
 2. Floating Actuators: Provide either a separate position feedback analog input control point, or alternatively, the position may be estimated by timing pulse-open and pulse-closed commands if combined with an auto-zeroing function whenever the damper or valve has been driven full closed. The second option is not acceptable for 24/7 systems / applications that lack an unoccupied mode of operation, unless a forced/override auto-zero is implemented at least once every 48 hours.
 3. Two-Position Actuators: Such valves may be ignored for the purposes of such control loop functions.
- Q. Temperature Alarms: If space temperatures that are monitored through the DDC system fall more than the adjustable alarm levels, the DDC system shall issue an alarm. Recommended alarm settings:
1. High limit for occupied spaces: 84 deg. F.
 2. High limit for data rooms: 80 deg. F.
 3. High limit for other unoccupied spaces: 104 deg. F.
 4. Low limit for occupied spaces: 58 deg. F.
 5. Low limit for unoccupied spaces: 52 deg. F.
- R. Status Monitoring of Motor Driven Equipment: All pump and fan status monitoring shall be achieved through current switches that have an adjustable trip point. Adjust so that setpoint is below minimum operating current and above motor no-load current.
1. Additionally, fans and pumps with flow measuring stations shall have a proof of flow point via the flow station. If current and air / water flow is not detected within 20 seconds of the signal for the fan to start, an alarm shall be issued at the operator's workstation and the fan / pump shall be de-energized.
- S. Space Thermostats: All DDC system space temperature sensors, except for those located in corridors, mechanical and electrical rooms, tele-data rooms, toilet rooms, stairways, entry vestibules, lobbies, and storage rooms shall be provided with a local temperature sensor override feature that permits the user to adjust the space temperature setpoint +/- 2 deg. F. (adjustable) away from the space temperature setpoint set by the DDC system via programming. Sensors shall also incorporate an occupancy override pushbutton that provides a binary input to the DDC system to indicate space occupancy.
- T. Run Time Totalization: The DDC system shall provide a run-time totalization feature for all fans, fan-containing equipment, pumps, boilers, fuel burners (e.g. furnaces boilers, etc.), and refrigerant compressors, and all other HVAC equipment controlled by the DDC system except as noted otherwise.

- U. Life Safety Damper Monitoring: The DDC system shall monitor the status of fire and , smoke , and combination fire/smoke dampers via the monitoring switch packaged furnished with the damper.
- V. Freezestats: Freezestats shall be installed in a uniform, horizontal serpentine pattern and in a downward direction from the body of the device. Element shall be exposed to all areas that encounter low temperature, including along the bottom of the coil(s), from end to end. Provide 1 foot of sensing element for each square foot of coil area. Provide as many freezestats as required for full coverage. Freezestats shall be of the automatic reset type, but a freeze trip only released by way of a manual command at the operator's workstation after three automatic re-start attempts within an 8 hour period.
- W. Safety Device Wiring: Unless explicitly noted otherwise, all safety switches/devices (e.g. freezestats, duct pressure limit switches, smoke detectors, etc.) shall be of the automatic reset type but shall provide a digital input (DI) to the DDC system, with software reset required through a manual command at the operator's workstation, with the exception of smoke detectors which shall be hardwired to the appropriate motor controller(s)
- X. Air System Maintenance Start-Stop Switches: A maintenance shutdown / start-up switch shall be provided for each AHU. Locate this switch near to the supply fan VFD. The switch shall provide a pair of binary inputs to the DDC system. Whenever the switch is positioned to 'off', the entire air system shall de-energized via software in the manner identical to the manual system shutdown command initiated through the DDC system interface. The 'on' position / input shall re-start the system in accordance with programming.
 - 1. Provide labeling on the supply and relief fan VFDs and disconnect switches referring staff to the maintenance switches for unit shutdown PRIOR to disconnecting power at service disconnect (safety) switches in order to prevent control system alarms.
 - 2. Provide labeling on the maintenance switches indicating that these switches are for control system software shutdown of the unit only, and that VFDs / disconnect switches must be locked and tagged prior to working on the unit.
- Y. Mixing Damper Control: Mixing dampers (outdoor air and return air) shall be provided with independent actuators (at least one actuator per damper) and independent analog output control signals from the DDC system controller. Single actuators using physically linked dampers and common control output signals are not acceptable.
 - 1. Linearization Tuning: The DDC system shall be configured to utilize only the linearly-responding portion of the full range stroke of each of the mixing dampers, so as to compensate for the non-linear control characteristic of each installed damper (i.e. due to lack of, or excess amount of, damper authority - as installed in the complete air handling system). By way of signal conversion, the full range of controller output (i.e. the full 0-10VDC range) shall correspond to only the portion (limited range) of the damper actuator stroke which allows the damper to function in a linear manner with respect to airflow rate. Example: Only controlling a parallel blade return damper from 0% to 20% open where that damper that has excessively low control authority (i.e. is quite oversized), in lieu of the damper ranging from 0% to 100% open.
 - a. The DDC system sub-contractor shall observe the response of the installed dampers in the system after start up, and during commissioning of the control system, shall

determine the required minimum and maximum settings of each damper individually to produce linear response of the air mixing process.

- b. If no supply airflow measuring station is present in the system, the Testing, Adjusting, and Balancing Agent shall assist in this process by measuring the mixed airflow (same as supply air) variation of the system, at constant fan speed with all terminal unit positions locked in place, over the full range of mixing damper stroke.
 - c. The linearization tuning process shall be considered acceptable when there is no more than 10% variation in mixed/ supply air flowrate over the entire mixing damper control signal range.
 - d. Damper override signals shall permit dampers to be stroked to any degree of open (anywhere from 0 to 100% / fully open).
 - e. Acceptable compliance approaches include:
 - 1) The DDC system supplier may utilize a Belimo SBG 24 Range Controller to achieve this requirement.
 - 2) Alternatively, duct blank-off plates may also be provided to decrease the functional size of dampers to increase control authority and allow for more linear response, but only with the pre-approval of the Architect / Engineer, where the plates do not interfere with the readings of an airflow measuring station, and only as a supplement to the linearization by damper range process.
 - 3) A custom linearization function to correct for a known (measured) damper position vs. airflow rate curve.
 - f. The linearization tuning process shall be considered acceptable when it has been observed and documented by flow measurements that there is no more than 10% variation in mixed/ supply air flowrate over the entire mixing damper control signal range.
- Z. Cascade Loops: Cascade loop methods of control over modulating (analog) output devices (e.g. variable speed supply fans, steam and hydronic control valves, etc.) shall be utilized wherever required to produce stable control while providing quick response required to prevent problematic operating conditions or safety shutdowns.
- 1. Example: Heating coil control valves shall be directly piloted from an averaging temperature sensor located immediately downstream of the coil, with the setpoint of that "local" control loop reset as required to provide the desired unit supply air temperature to the spaces, as measured by a temperature sensor in the main supply air duct connected to the air handling unit. The local HW valve control loop shall be quick reacting, with the reset loop slower reacting. By this method, the heating coil can produce proper temperature air quickly in response to rapid changes in upstream variables to prevent freeze/ stat trips or frozen coils, but without the risk of HW valve hunting and other instabilities due to system inertia between the heating coil and the main AHU supply air temperature sensor.
- AA. Duct and Plenum Air Temperature Sensor Applications: Use averaging type temperature sensors in ductwork greater than 48" in any dimension, where air temperature stratification exists (such as a mixed air plenum), immediately downstream of an air blender, and immediately downstream of any heat exchanging element (coil, furnace, energy recovery heat exchanger, etc.).
- BB. Dead-bands: Control loops shall incorporate dead-bands of an appropriate range in order to prevent 'hunting' or excessive 'cycling' of the output device (e.g. variable speed fan controlled to

remote duct static pressure, space temperature sensor controlling an on-off exhaust fan, etc.). Dead-band ranges shall be adjustable, with proposed initial settings indicated on the ATC primary submittal.

- CC. Optimal Start Warm-Up and Cool-Down Modes: Air handling units and similar air systems with time of day schedules (i.e. not continuous operation) shall incorporate warm up and cool down cycles. The units shall be operated in advance of an occupancy period, with a minimum outdoor airflow rate of zero (0) cfm. The duration of this warm up / cool down period shall be auto-adaptive and dependent on the outdoor air temperature and at least one representative space temperature input signal.
- DD. Airflow Measurement of Fan Arrays: The DDC system shall monitor the airflow rate of each individual fan in the array, and shall sum the airflow values from all operating fans to determine the total airflow rate of the array.

1.5 SEQUENCES OF OPERATION

A. Multizone RTU (typical of 1)

Run Conditions - Requested:

The unit shall run whenever:

- Any zone is occupied.
- OR a definable number of unoccupied zones need heating or cooling.

Freeze Protection:

The unit shall shut down and generate an alarm upon receiving a freezestat status.

Supply Air Smoke Detection:

The unit shall shut down and generate an alarm upon receiving a supply air smoke detector status.

Supply Fan:

The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Cold Deck - Cooling Supply Air Temperature Setpoint - Fixed:

The unit shall maintain a fixed cooling supply air temperature setpoint of 55°F (adj.).

Cold Deck - Cooling Stages:

The controller shall measure the cooling supply air temperature and stage the cooling to maintain its setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the supply fan status is on.

Alarms shall be provided as follows:

- High Cooling Supply Air Temp: If the cooling supply air temperature is 5°F (adj.) greater than setpoint.

Hot Deck - Heating Supply Air Temperature Setpoint - Optimized:

The heating supply air temperature setpoint shall be reset using a trim and respond algorithm based on zone heating requirements. If there is a demand for heating then the setpoint shall be reset to a higher value (adj.). If the demand for heating decreases then the setpoint shall reset to a lower value (adj.). Once the zones are satisfied then the setpoint shall gradually moderate over time to reduce heating energy use.

The supply air temperature setpoint shall be reset based on zone heating requirements as follows:

- The initial supply air temperature setpoint shall be 82°F (adj.).
- As heating demand increases, the setpoint shall incrementally reset up to a maximum of 90°F (adj.).
- As heating demand decreases, the setpoint shall incrementally reset down to a minimum of 72°F (adj.).

Hot Deck - Gas Heating Stages:

The controller shall measure the heating supply air temperature and stage the heating to maintain its setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.

The heating shall be enabled whenever:

- Outside air temperature is less than 70°F (adj.).
- AND the supply fan status is on.

Alarms shall be provided as follows:

- High Heating Supply Air Temp: If the heating supply air temperature is greater than 120°F (adj.).
- Low Heating Supply Air Temp: If the heating supply air temperature is 5°F (adj.) less than setpoint.

Economizer:

The controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the cooling supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer shall be enabled whenever:

- Outside air temperature is less than 70°F (adj.).
- AND the outside air enthalpy is less than 22Btu/lb (adj.)
- AND the outside air temperature is less than the return air temperature.
- AND the outside air enthalpy is less than the return air enthalpy.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 40°F to 35°F (adj.)
- OR on loss of supply fan status.
- OR the freezestat (if present) is on.

The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

Minimum Outside Air Ventilation - Fixed Percentage:

The outside air dampers shall maintain a minimum position (adj.) during building occupied hours and be closed during unoccupied hours.

Mixed Air Temperature:

The controller shall monitor the mixed air temperature and use as required for economizer control (if present) and preheating control (if present).

Alarms shall be provided as follows:

- High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
- Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

Return Air Humidity:

The controller shall monitor the return air humidity and use as required for economizer control (if present).

Alarms shall be provided as follows:

- High Return Air Humidity: If the return air humidity is greater than 60% (adj.).
- Low Return Air Humidity: If the return air humidity is less than 5% (adj.).

Return Air Temperature:

The controller shall monitor the return air temperature and use as required for economizer control (if present).

Alarms shall be provided as follows:

- High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
- Low Return Air Temp: If the return air temperature is less than 50°F (adj.).

B. Multizone Zone Dampers (typical of 9):

Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
 - A 75°F (adj.) cooling setpoint
 - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
 - A 80°F (adj.) cooling setpoint.
 - A 60°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Demand Limiting - Zone Setpoint Optimization:

To lower power consumption, the zone setpoints shall automatically relax when the facility power consumption exceeds definable thresholds. The amount of relaxation shall be individually configurable for each zone. The zone setpoints shall automatically return to their previous settings when the facility power consumption drops below the thresholds.

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Zone Optimal Start:

The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:

A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Zone Damper Control:

The cooling and heating deck zone dampers shall modulate in sequence to maintain zone temperature cooling and heating setpoints.

Discharge Air Temperature:

The controller shall monitor the discharge air temperature.

Alarms shall be provided as follows:

- High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).
- Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

Zone Humidity:

The controller shall monitor the zone humidity.

Alarms shall be provided as follows:

- High Zone Humidity: If the zone humidity is greater than 60% (adj.).
- Low Zone Humidity: If the zone humidity is less than 35% (adj.).

Environmental Index:

When the zone is occupied, the controller will monitor the deviation of the zone temperature from the heating or cooling setpoint. The controller will also monitor the relative humidity and compare it to comfort conditions. This data will be used to calculate a 0 - 100% Environmental Index which gives an indication of how well the zone is maintaining comfort. The controller will also calculate the percentage of time since occupancy began that the Environmental Index is 70% or higher. Optionally, a weighting factor can be configured to adjust the contribution of the zone to the rollup average index based upon the floor area of the zone, importance of the zone, or other static criteria.

1.6 POINTS LIST

A. Multizone RTU:

| Point Name | Hardware Points | | | | Software Points | | | | | | Show On Graphic | |
|---------------------------|-----------------|--------|----|----|-----------------|----|------|-------|-----------|-----------|-----------------|---|
| | AI | A O | BI | BO | AV | BV | Loop | Sched | Tren d | Alar m | | |
| Cooling Supply Air Temp | x | | | | | | | | | x | | x |
| Heating Supply Air Temp | x | | | | | | | | | x | | x |
| Mixed Air Temp | x | | | | | | | | | x | | x |
| Return Air Humidity | x | | | | | | | | | x | | x |
| Return Air Temp | x | | | | | | | | | x | | x |
| Mixed Air Dampers | | x | | | | | | | | x | | x |
| Freezestat | | | x | | | | | | | x | x | x |
| Supply Air Smoke Detector | | | x | | | | | | | x | x | x |
| Supply Fan Status | | | x | | | | | | | x | | x |
| Cooling Stage 1 | | | | x | | | | | | x | | x |
| Cooling Stage 2 | | | | x | | | | | | x | | x |
| Heating Stage 1 | | | | x | | | | | | x | | x |
| Heating Stage 2 | | | | x | | | | | | x | | x |
| Heating Stage 3 | | | | x | | | | | | x | | x |
| Heating Stage 4 | | | | x | | | | | | x | | x |

| Point Name | Hardware Points | | | | Software Points | | | | | | Show On Graphic |
|------------------------------------|-----------------|----------|----------|----------|-----------------|----------|----------|----------|-----------|-----------|-----------------|
| | AI | A O | BI | BO | AV | BV | Loop | Sched | Tren d | Alar m | |
| Supply Fan Start/Stop | | | | x | | | | | x | | x |
| Cooling Supply Air Temp Setpoint | | | | | x | | | | x | | x |
| Economizer Mixed Air Temp Setpoint | | | | | x | | | | x | | x |
| Heating Supply Air Temp Setpoint | | | | | x | | | | x | | x |
| Compressor Runtime Exceeded | | | | | | | | | | x | |
| High Cooling Supply Air Temp | | | | | | | | | | x | |
| High Heating Supply Air Temp | | | | | | | | | | x | |
| High Mixed Air Temp | | | | | | | | | | x | |
| High Return Air Humidity | | | | | | | | | | x | |
| High Return Air Temp | | | | | | | | | | x | |
| Low Heating Supply Air Temp | | | | | | | | | | x | |
| Low Mixed Air Temp | | | | | | | | | | x | |
| Low Return Air Humidity | | | | | | | | | | x | |
| Low Return Air Temp | | | | | | | | | | x | |
| Supply Fan Failure | | | | | | | | | | x | |
| Supply Fan in Hand | | | | | | | | | | x | |
| Supply Fan Runtime Exceeded | | | | | | | | | | x | |
| Totals | 5 | 1 | 3 | 7 | 3 | 0 | 0 | 0 | 19 | 15 | 19 |

Total Hardware (16)

Total Software (37)

B. Multizone Zone Dampers:

| Point Name | Hardware Points | | | | Software Points | | | | | | Show On Graphic |
|----------------------|-----------------|--------|----|----|-----------------|----|------|-------|-----------|-----------|-----------------|
| | AI | A O | BI | BO | AV | BV | Loop | Sched | Tren d | Alar m | |
| Discharge Air Temp | x | | | | | | | | x | | x |
| Zone Humidity | x | | | | | | | | x | | x |
| Zone Setpoint Adjust | x | | | | | | | | | | x |
| Zone Temp | x | | | | | | | | x | | x |
| Zone Damper | | x | | | | | | | | | |

| Point Name | Hardware Points | | | | Software Points | | | | | | Show On Graphic |
|---------------------------|-----------------|----------|----------|----------|-----------------|----------|----------|----------|-----------|-----------|-----------------|
| | AI | A O | BI | BO | AV | BV | Loop | Sched | Tren d | Alar m | |
| Zone Override | | | x | | | | | | x | | x |
| Cold Deck Damper Position | | | | | x | | | | x | | x |
| Cooling Setpoint | | | | | x | | | | x | | x |
| Environmental Index | | | | | x | | | | x | | |
| Heating Setpoint | | | | | x | | | | x | | x |
| Hot Deck Damper Position | | | | | x | | | | x | | x |
| Percent of Time Satisfied | | | | | x | | | | x | | |
| Schedule | | | | | | | | x | | | |
| High Discharge Air Temp | | | | | | | | | | x | |
| High Zone Humidity | | | | | | | | | | x | |
| High Zone Temp | | | | | | | | | | x | |
| Low Discharge Air Temp | | | | | | | | | | x | |
| Low Zone Humidity | | | | | | | | | | x | |
| Low Zone Temp | | | | | | | | | | x | |
| Totals | 4 | 1 | 1 | 0 | 6 | 0 | 0 | 1 | 10 | 6 | 9 |

Total Hardware (6)

Total Software (23)

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 231123 - FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes piping, valves and accessories to connect gas-fired equipment to natural gas systems.

1.3 DEFINITIONS

- A. Low-Pressure Facility Natural Gas Piping: Operating pressure of 0.5 psig or less.
- B. Medium-Pressure Facility Natural Gas Piping: Operating pressure greater than 0.5 psig, but not greater than 2 psig.
- C. High-Pressure Facility Natural Gas Piping: Operating pressure greater than 2 psig.
- D. Gas Service: Pipe from gas main or other source to gas point of delivery for building being served. Piping includes gas service piping, gas valve, meter bar or meter support, and gas meter.
- E. Gas Delivery Point: Gas meter or service pressure regulator outlet, or gas service valve if gas meter is not provided.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Minimum Working-Pressure Ratings: Except where otherwise indicated, minimum pressure requirements are as follows:
 - 1. Low-Pressure Facility Natural Gas Piping: 2 psig.
 - 2. Medium-Pressure Facility Natural Gas Piping: 10 psig.
 - 3. High-Pressure Facility Natural Gas Piping: 20 psig.
- B. Approximate values of natural gas supplied for these systems are as follows:
 - 1. Heating Value: 1000 Btu/cu. ft.
 - 2. Specific Gravity: 0.6.

1.5 ACTION SUBMITTALS

- A. Provide product data for each type of natural gas specialty and special-duty valve. Include pressure rating, rated capacity, and settings of selected models.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings for Facility Natural Gas Piping, including required clearances and relationship to other services for same work areas.
- B. Test reports specified in "Field Quality Control" Article in Part 3.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance data for natural gas specialties and special-duty valves to include in the operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Comply with NFPA 54, "National Fuel Gas Code," for gas piping materials and components; installations; and inspecting, testing, and purging.
- B. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
- C. Listing and Labeling: Provide equipment and accessories specified in this Section that are listed and labeled.
 - 1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify gas supplier. Handle flammable liquids with proper precautions and do not leave on premises from end of one day to beginning of next day.

1.10 SEQUENCING AND SCHEDULING

- A. Notification of Interruption of Service: Notify each affected user when gas supply will be turned off.
- B. Work Interruptions: Leave gas piping systems in safe condition when interruptions in work occur during repairs or alterations to existing gas piping systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Gas Stops, 2-Inch NPS and Smaller:
 - a. Hammond Valve Corp.
 - b. Maxitrol Co.
 - c. Milwaukee Valve Co., Inc.
 - d. Mueller Co.
 - e. National Meter.
 2. Gas Valves, 2-Inch NPS and Smaller:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Milwaukee Valve Co., Inc.
 - c. Mueller Co.
 - d. National Meter.
 3. Gas Valves, 2-1/2-Inch NPS and Larger:
 - a. Core Industries, Inc.; Mueller Steam Specialty Div.
 - b. Huber: J.M. Huber Corp.; Flow Control Div.
 - c. Nordstrom Valves, Inc.
 - d. Olson Technologies, Inc.
 - e. Xomox Corp.

2.2 PIPES

- A. Steel Pipe: ASTM A 53; Type E or Type S; Grade B; Schedule 40; black.

2.3 PIPE FITTINGS

- A. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends conforming to ASME B1.20.1.
- B. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends conforming to ASME B1.20.1.
- C. Steel Fittings: ASME B16.9, wrought steel, butt-welding type; and ASME B16.11, forged steel.
- D. Steel Flanges and Flanged Fittings: ASME B16.5.
- E. Transition Fittings: Type, material, and end connections to match piping being joined.

2.4 JOINING MATERIALS

- A. Common Joining Materials: Refer to Division 23 Section "Common Work Results for HVAC" for joining materials not included in this Section.
- B. Joint Compound and Tape: Suitable for natural gas.
- C. Gasket Material: Thickness, material, and type suitable for natural gas.

2.5 VALVES

- A. Manual Valves: Conform to standards listed or, where appropriate, to ANSI Z21.15.
- B. Gas Stops, 2-Inch NPS and Smaller: AGA-certified, bronze-body, plug type with bronze plug, ball type with chrome-plated brass ball, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal, for 2 psig or less natural gas. Include AGA stamp, flat or square head or lever handle, and threaded ends conforming to ASME B1.20.1.
 - 1. Locking Device: Include locking (tamperproof) feature, where indicated on drawings.
- C. Gas Valves, 2-Inch NPS and Smaller: ASME B16.33, 150 psig WOG, bronze body, bronze plug, straightaway pattern, square head, tapered-plug type, with threaded ends conforming to ASME B1.20.1.
- D. Gas Valves, 2-1/2-Inch NPS and Larger: MSS SP-78, Class 125 or Class 175 WOG, nonlubricated-plug type with polytetrafluoroethylene (PTFE) lining or sleeve, semi-steel body, wrench operated, with flanged ends.
 - 1. Locking Device: Include locking (tamperproof) feature, where indicated on drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Comply with NFPA 54 Paragraph "Prevention of Accidental Ignition."

3.2 PIPING APPLICATIONS

- A. General: Flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating may be used in applications below, except where otherwise indicated.
- B. Low-Pressure, 0.5 psig or Less, Natural Gas Systems: Use the following:
 - 1. 2-Inch and Smaller: Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. 2-1/2- to 6-Inch NPS: Steel pipe, butt-welding fittings, and welded joints.

- C. Medium and High Pressure, Greater than 0.5 psig, Natural Gas Systems: Use steel pipe with steel welding fittings and welded joints.
- D. Regulator Vent Piping: Use steel pipe with steel welding fittings and welded joints. Terminate regulator vent piping with a screened fitting to prevent the entry of foreign substances.

3.3 VALVE APPLICATIONS

- A. Use gas stops for shutoff to appliances with 2-inch NPS or smaller low-pressure gas supply.
- B. Use gas valves for shutoff to appliances with 2-1/2-inch NPS or larger low-pressure gas supply and all sizes for medium-pressure gas supply.
- C. Use gas valves of sizes indicated for gas service piping, meters, mains, and where indicated.

3.4 PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Common Work Results for HVAC " for basic piping installation requirements.
- B. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of gas meter. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- C. Install gas piping at uniform grade of 0.1 percent slope upward toward risers.
- D. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- E. Connect branch piping from top or side of horizontal piping.
- F. Install unions in pipes 2-inch NPS and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- G. Install dielectric fittings (unions and flanges) with ferrous and brass or bronze end connections, separated by insulating material, where piping of dissimilar metals is joined.
- H. Install dielectric fittings (unions and flanges) with 2 ferrous end connections, separated by insulating material, at outlet from gas meter and, where indicated, for ferrous piping.
- I. Install flanges on valves and equipment having 2-1/2-inch NPS and larger connections.
- J. Anchor piping to ensure proper direction of piping expansion and contraction. Install expansion joints, expansion loops, and pipe guides as indicated.

- K. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with approved vent fitting.

3.5 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping joint construction.
- B. Use materials suitable for natural gas service.

3.6 VALVE INSTALLATION

- A. Install valves in accessible locations, protected from damage. Tag valves with metal tag indicating piping supplied. Attach tag to valve with metal chain.
 - 1. Refer to Division 23 Section "Identification for HVAC" for valve tags.
- B. Install gas valve upstream from each gas pressure regulator. Where 2 gas pressure regulators are installed in series, valve is not required at second regulator.
- C. Install pressure relief or pressure-limiting devices so they can be readily operated to determine if valve is free; test to determine pressure at which they will operate; and examine for leakage when in closed position.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for pipe hanger and support devices.
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. 1/2-Inch NPS: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 2. 3/4- and 1-Inch NPS: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 3. 1-1/4-Inch NPS: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. 1-1/2- and 2-Inch NPS: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 5. 2-1/2- to 3-1/2-Inch NPS: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 6. 4-Inch NPS and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- C. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- D. Provide additional hangers at each change of direction of piping and at concentrated equipment loads.

3.8 CONNECTIONS

- A. Install gas piping next to equipment and appliances using gas to allow service and maintenance.
- B. Connect gas piping to equipment and appliances using gas with shutoff valves and unions. Install gas valve upstream from and within 72 inches of each appliance using gas. Install union or flanged connection downstream from valve. Include flexible connectors when indicated.
- C. Sediment Traps: Install tee fitting with capped nipple in bottom forming drip, as close as practical to inlet for appliance using gas.

3.9 ELECTRICAL BONDING AND GROUNDING

- A. Install aboveground portions of Facility Natural Gas Piping systems that are upstream from equipment shutoff valves, electrically continuous, and bonded to grounding electrode according to NFPA 70.
- B. Do not use gas piping as grounding electrode.

3.10 FIELD QUALITY CONTROL

- A. Inspect, test, and purge piping according to NFPA 54, Part 4 "Gas Piping Inspection, Testing, and Purging" and requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- D. Verify capacities and pressure ratings of gas meters, regulators, valves, and specialties.
- E. Verify correct pressure settings for pressure regulators.
- F. Verify that specified piping tests are complete.

3.11 PAINTING

- A. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex, gloss.
 - d. Color: Yellow.

3.12 ADJUSTING

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 231123

SECTION 233113 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Division 23 Sections include the following:
 - 1. "Hangers and Supports for HVAC Piping and Equipment" for general requirements and delegated design and engineering responsibility for exterior ductwork supports and wind restraints.
 - 2. "Vibration Controls for HVAC" for ductwork vibration isolators.
 - 3. "HVAC Duct Insulation" for duct insulation other than duct liner.
 - 4. "Air Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, flexible ducts, and other duct mounted specialties.
 - 5. "Testing, Adjusting, and Balancing for HVAC" for air balancing and final adjusting of manual-volume dampers.

1.2 SUMMARY

- A. This Section includes rectangular and round metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 10- to plus 10-inch w.g. Products specified herein include the following:
 - 1. Single-wall, rectangular ducts and fittings.
 - 2. Single-wall round spiral-seam ducts and formed fittings.
 - 3. Double-wall round spiral-seam ducts and formed fittings.
 - 4. Double-wall, rectangular ducts and fittings.
 - 5. Sealants and gaskets.
 - 6. Duct liner.

1.3 INTERPRETATION OF THE DRAWINGS

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Ductwork indicated on the Drawings is schematic; therefore, changes in ductwork sizes and/or location shall be made when necessary to conform to project conditions. Offsets, rises, drops, and duct profile changes shall be made at no additional cost to the Owner. The Architect / Engineer shall be consulted for approval of duct size changes which cannot maintain the same equivalent flow area and friction rate, require a duct aspect ratio exceeding 4 to 1, or represent a fundamental change to the configuration of duct system. Proposed changes must be specifically approved in writing by Architect / Engineer prior

to being implemented. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

- B. Duct dimensions indicated on Drawings are the required clear, inside dimensions. Adjust sheet metal dimensions to account for duct liner or double wall construction. Note that, typically, the first dimension listed on the Drawings is that of the side visible in the particular 2D view (plan, section, etc.).
- C. The Drawings schematically indicate fitting types. All proposed changes in fitting types shown on the Drawing or specified in this Section shall be approved in writing by the Architect / Engineer prior to being implemented.
- D. Turning vanes not shown on the Drawings for mitered rectangular elbows have been omitted for clarity purposes only. The Contractor shall provide turning vanes as required by this Section regardless of drawing depiction.
 - 1. At the Contractor's option, radius type elbows with 1.5 or 1.0 centerline radius to duct width ratio may be provided in lieu of mitered elbows shown on the Drawings where the duct width in the plane of change in direction is less than 14", provided that the elbow fits in the space available.
 - 2. Mitered elbows shall not be substituted for a radius type elbows shown on the Drawings unless specifically approved by the Architect / Engineer.

1.4 PERFORMANCE REQUIREMENTS

- A. Duct Construction: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in this Section, and elsewhere in the Contract Documents.
 - 1. Where the requirements of this specification section exceed SMACNA requirements or where a prohibition of specific type of work contained in the SMACNA standard is made, the requirements of this specification section shall take precedence.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity and wind loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.5 ACTION SUBMITTALS

- A. Product Data: For prefabricated ductwork, duct components, duct liner, sealant and gasket materials.

B. Shop Drawings: Show details of the following:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and pressure classes.
4. Elevations of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Penetrations through the roof and exterior walls.
11. Equipment installation based on equipment being used on Project.
12. Duct accessories, including dampers and access doors.
13. Hangers and supports, including methods for duct and building attachment, and vibration isolation.
14. Control dampers, airflow measuring stations, temperature and pressure sensors, and all other control devices required. Coordinate with the work of the ATC Sub-contractor as described in Division 23 Section "Instrumentation and Control for HVAC".

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Refer to Division 23 Section "Common Work Results for HVAC" for additional coordination drawing requirements. Show the following:

1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
4. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
5. Other items required to be included as per the provisions of Division 23 Section "Common Work Results for HVAC".

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements for the following:

1. Pressure and leakage tests.
2. Duct system cleanliness tests.

1.7 CLOSEOUT SUBMITTALS

A. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.8 QUALITY ASSURANCE

- A. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Generally, ductwork and ductwork supports shall meet the requirements of SMACNA's Publication "HVAC Duct Construction Standards--Metal and Flexible", 3rd Edition (2005), and various other SMACNA Publications referenced in this specification section. However, where the requirements of this specification section exceed SMACNA requirements or where a prohibition of specific type of work contained within or permitted by the SMACNA standard is made, the requirements of this specification section shall take precedence.
- B. Minimum Seal Class Requirements: Conform to requirements of 2012 International Energy Conservation Code , and the referenced SMACNA standards and ASHRAE Standard 90.1-2013 except where these specifications exceed those requirements.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.
- D. Protect shop fabricated and factory fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings with a polyethylene film with a high-tack adhesive to attach to the ductwork and accessories. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with polyethylene waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fibrous-Glass Duct Liner:
 - a. CertainTeed Corp.; Insulation Group.
 - b. Johns Manville International, Inc.
 - c. Knauf Fiber Glass GmbH.
 - d. Owens Corning.

2. Single Wall Round Prefabricated Ducts and Fittings:
 - a. Hranec Sheet Metal Inc.
 - b. Linx Industries Inc.
 - c. McGill AirFlow LLC
 - d. MKT Metal Manufacturing
 - e. SEMCO LLC
 - f. Sheet Metal Connectors, Inc.
 - g. Spiral Manufacturing Co., Inc.

3. Round Prefabricated Connectors:
 - a. Ductmate Industries, Inc.
 - b. Hranec Sheet Metal Inc.
 - c. Linx Industries Inc.
 - d. McGill AirFlow LLC
 - e. MKT Metal Manufacturing
 - f. SEMCO LLC
 - g. Sheet Metal Connectors, Inc.
 - h. Spiral Manufacturing Co., Inc.

4. Double-Wall Round Ducts and Fittings:
 - a. Hranec Sheet Metal Inc.
 - b. Linx Industries Inc.
 - c. McGill AirFlow LLC
 - d. MKT Metal Manufacturing
 - e. SEMCO LLC
 - f. Sheet Metal Connectors, Inc.
 - g. Spiral Manufacturing Co., Inc.

5. Double-Wall Rectangular Ducts and Fittings:
 - a. Hranec Sheet Metal Inc.
 - b. McGill AirFlow LLC
 - c. MKT Metal Manufacturing
 - d. Sheet Metal Connectors, Inc.

6. Sealant and Gaskets:
 - a. Ductmate Industries
 - b. Carlisle Hardcast
 - c. Childers; a Div. of HB Fuller Construction Products Inc.
 - d. McGill Airflow LLC
 - e. Foster; a Div. of HB Fuller Construction Products Inc.

7. Flanged Duct Connector Systems for Rectangular Duct:
 - a. Ductmate '35' and '45' systems.
 - b. CL Ward "J" and "H" flange and corner systems.

- c. Hardcast / Nexus "J" and "G" flange and corner systems.
 - d. Ward Industries / Hart and Cooley "FLGJ" and "FLGH" systems
 - e. Note: SMACNA joint types T-25a and T-25b (TDC and TDF type connectors, respectively) using corner pieces provided by the above listed manufacturers are also acceptable.
8. Flanged Duct Connector Systems for Round Duct:
- a. Ductmate 'Spiralmate'.
9. Prefabricated Flashed-In Roof Support Rails and Curbs:
- a. Greenheck Fan Corp.
 - b. MKT Metal Manufacturing
 - c. MicroMetl Corp.
 - d. Roof Products and Systems (RPS); a Div. of Hart and Cooley Inc.
 - e. Thycurb. Inc.
 - f. The Pate Co.
 - g. PortalsPlus; a Div. of Hart and Cooley Inc.
 - h. United Enertech Corp.
10. Steel Cable Hanger Systems:
- a. Ductmate 'Clutcher'
 - b. DuroDyne 'Dyna-Tite' Series
 - c. Gripple Inc. 'Standard Hanger' Series

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, except as otherwise indicated or modified by this Section. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653 or ASTM A 924, G90 coating designation. Minimum thickness permitted shall be 24 gauge, except for round spiral seam ductwork which shall have a minimum thickness of 26 gauge.
 - 1. Thickness Exception for Breakout Noise Reduction: Provide minimum 20 gauge sheet for all portions of the supply, return, and exhaust duct systems located inside the building within 30 feet of each AHU, RTU, or exhaust fan connection, down all flow paths, as measured along the length of the centerline of the ductwork, and for all duct shapes (e.g. round, rectangular, and flat oval).
 - 2. Galvanizing Exception: Ducts of all services located outside the building shall be constructed of galvanized steel sheet with a minimum G115 (or higher) coating designation (unless such ducts are indicated elsewhere to be constructed of a material other than galvanized steel).

- C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches. Maximum diameter permitted is 1/2".

2.3 FIBROUS GLASS DUCT LINER

- A. General: Comply with NFPA 90A and NAIMA's "Fibrous Glass Duct Liner Standard."
- B. Where Required:
 - 1. Transfer air ducts.
- C. Materials: ASTM C 1071, Type II (rigid sheet), with the surface exposed to airstream coated with an approved surface covering to prevent erosion of glass fibers in duct systems operating with velocities as high as 6000 feet per minute. Coatings shall meet the requirements of NFPA 90A and shall be impregnated with an EPA-Registered biocide to inhibit mold and bacteria growth. Insulation shall be treated with a biocide to inhibit biological growth.
 - 1. Minimum Thickness: 1 inch.
 - 2. Thermal Conductivity (k-Value): No more than 0.27 at 75 deg F mean temperature.
 - 3. Fire-Hazard Classification: Maximum flame-spread rating of 25 and smoke-developed rating of 50, when tested according to ASTM E84 or UL 723.
 - 4. Liner Adhesive: Comply with NFPA 90A and ASTM C 916.
 - 5. For RoundDucts: Provide a liner specifically manufactured for this purpose (e.g. Johns Manville 'Spiracoustic Plus', "CertainTeed "Ultra-Round", or Owens Corning "QuietZone", etc.). Do not use liner intended for rectangular ducts in round ductwork.
 - a. All round ductwork on portions of the ductwork systems indicated to receive liner shall be provided with liner, including, but not limited to, round branch duct connections to diffusers. The only exception is round ducts with clear inside diameters of less than 6".
- D. Insulation Pins and Washers for Liner in Rectangular Ducts: Fasteners shall not damage liner when applied as recommended by manufacturer or cause leakage in duct.
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer. Pin lengths as required for liner thickness, without compressing the liner more than 10% or the pin protruding into the duct more than 1/8".
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

2.4 SEALANT AND GASKETS

- A. Tapes: One-step (peel and stick) pressure-sensitive duct sealing tapes, two-part tape systems, and similar sealing tapes are not permitted for sealing metal duct joints and penetrations.
- B. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL. Sealants shall be UL-181B-M listed.
- C. Indoor Duct Water-Based Joint and Seam Sealant:
1. Application Method: Brush-on or trowel-on to minimum 1/16" thickness to joints and seams. Application temperature range: 40 to 100 deg F.
 2. Solids Content: Minimum 68 percent.
 3. Shore A Hardness: Minimum 72.
 4. Shall be permanently flexible and water, mold, and mildew resistant after curing.
 5. Adhesion Strength per ASTM C794 to Bright Annealed Stainless Steel: 6.25 PLI
 6. VOC Content: Maximum 30 g/L (less water).
 7. UL 181B-M listed; UL 723 Classified.
 8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 9. Service Application: Indoor duct installations, except for unconditioned outdoor air ducts.
 10. Acceptable Products: Ductmate 'PROseal', Foster '32-19 Duct-Fas', or Childers 'Chil-Flex CP-146'.
- D. Outdoor Duct Joint and Seam Sealant: Polymeric rubber, resins, and fiber-reinforcing materials dispersed in solvent. Applied by brush or trowel, with a 24-hour cure time. Sealant shall be UV resistant, impervious to water, and shall be permanently flexible with an operational temperature range of -20 to +150 deg. F. Sealant shall be UL 181 A-M / B-M Listed and UL 723 Classified. Maximum VOC: 420 g/L.
1. Service Application: Ductwork located outside the building.
 2. Acceptable Products: McGill Airflow LLC 'Uni-Weather', Ductmate Industries 'SOLVseal', or Carlisle HVAC 'Sure-Grip 404'.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
1. Comply with UL 723 and meet Mil-C 18969B and TTS-S-001657. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth.
 2. The use of gaskets with adhesive properties on fitting and duct connections shall not substitute for fastening hardware.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Supports shall comply with Chapter 5 of the SMACNA Publication "HVAC Duct Construction Standards--Metal and Flexible, 3rd Edition, 2005, except as modified by this section.

B. Building Attachments: mechanical-expansion fasteners , or structural-steel fasteners appropriate for building materials.

1. Do not use strap type attachments or friction type beam clips / clamps (e.g. hammer-on / slide-on flange clips and similar devices).
 - a. C-type beam clamps that incorporate a bolt for fastening, consistent with MSS Types 19 and 23, are acceptable.

C. Hanger Materials: Galvanized, sheet steel straps, wire rope locking cable hanger system or round, threaded steel rod. Strap galvanizing shall be G90, or matching that of the supported duct, whichever is greater.

1. Exceptions to the Above:
 - a. Hangers, supports, and fasteners for exterior ducts shall be hot dipped galvanized or stainless steel.
2. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
3. Do not use wirehangers unless explicitly specified elsewhere in this Section.

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

1. Fasteners for interior galvanized ducts shall be zinc or cadmium coated.
2. Fasteners for exterior ducts not concealed by weatherproofing lagging shall be hot dipped galvanized or stainless steel.
3. Blind rivets using pull-through mandrels are not permitted if they leave holes for air leakage. Fasteners shall not project into duct interiors more than 1/2".

E. Trapeze and Riser Supports: Steel shapes shall comply with ASTM A 36.

1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.

- F. Steel Cable Hanger Systems: Factory-fabricated system of steel wire cables, locking cable anchors, and related accessories for the support of horizontal ducts which do not exhibit, or have been restrained from, lateral movement during system operation. All products shall be from a single manufacturer, and shall have been tested by SMACNA Testing and Research Institute and found to conform to the requirements of the "HVAC Duct Construction Standards, Metal and Flexible" for upper and lower attachments. Hangers shall be factory engineered for a 5 to 1 safety factor.
1. Steel Cables: Galvanized steel complying with ASTM A 603 or Stainless steel complying with ASTM A 492.
 2. Steel Cable Locks / End Connections: Cadmium or zinc-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
 3. Stress Distribution Corner Guards: Used with uninsulated rectangular duct to prevent cable stress or deformation of the ductwork. Corner brackets are an acceptable alternative so long as the ductwork is not material handling or of fully welded construction.
 4. Acceptable Upper Attachments Are Limited to the Following:
 - a. Cable loops around building structural steel and supplemental steel where the minimum required cable bending radius is ensured, and channel support system attachments in steel structure buildings.

2.6 NON-PENETRATING ROOFTOP DUCTWORK SUPPORT SYSTEMS

- A. All ductwork located on the roof shall be supported by factory fabricated and engineered support system using with structural steel members bearing on support bases that do not penetrate the roofing system. Provide bracing members, bolts, nuts, washers and other accessories required to provide a complete system. All structural members and fasteners shall be hot dipped galvanized in accordance with ASTM A 153 or A 123.
1. Where exterior structural steel members are cut, drilled or welded, or galvanizing is damaged, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.
- B. All duct supports shall set the bottom of the ductwork no less than 18" above the finished roof surface. Additional clearance may be required, depending on the duct width. Comply with Figure 6-4 of the referenced SMACNA standard.
1. The supports shall be dimensioned to account for field applied insulation.
 2. Duct support spacing shall comply with the referenced SMACNA standard.
- C. Prefabricated system shall be specifically designed for outdoor use and installation without roof penetrations, flashing or damage to roof materials (insulation, membrane, etc.). Duct support bases shall be molded high density/high impact polypropylene with UV inhibitors and anti-oxidants.
1. Prior to installation, verify compatibility with the existing roof membrane.

2. Provide roof pads. Consult manufacturer of the roofing system as to the type of isolation pads required between the roof and base.
 3. The system shall not void the existing roof bond.
- D. The entire duct support system shall be factory engineered and designed for each project, for the specific weight and dimensions of the duct systems supported as well as the snow and wind classification for the geographic area the system is located.
1. The maximum allowable loadings per support base shall be based on the exact type of roof insulation present, using a safety factor of 2.0 against published minimum ultimate values of insulation compression strength (NRCA Commercial Low-Slope Roofing Materials Guide, 1994 Edition). The manufacturer must also ensure adequacy against punching resistance and overall structural integrity of the roof on which the assembly is placed.
 2. If tie-down anchors and/or guy wires are required by the support system in order to achieve the wind classifications, the Division 23 Contractor shall include in his/her bid price the cost of providing the anchors, including roofing repair, connection to the building structural system, and the required field engineering and design.
 - a. Calculated loads and structural attachment details shall be submitted to the Architect / Engineer for approval.
- E. When requested by the Architect or Engineer, provide a factory-trained representative of the manufacturer to visit the site while the work is in progress to assure that the installation conforms to the support system manufacturer's design and installation requirements.
- F. Acceptable Products: Subject to compliance with the requirements, provide products by one of the following:
1. Pentair / Caddy Pyramid Support Systems – 4-sided unistrut duct support frame mounted on "H-Frame" type support bases.
 2. PHP Systems / Design – 'PHP-D Enclosed' supports.
 3. Big Foot Systems – 'Multi-Foot' and 'H-Frame' systems.
 4. Miro Industries, Inc. – "DS" Series supports with 4-sided enclosure.

2.7 PREFABRICATED FLASHED-IN ROOF CURBS FOR DUCT PENETRATIONS

- A. Provide prefabricated curbs for the penetration of ductwork through the roof. Curbs shall be secured to the roof structural system (not including metal decks). Hardwood blocking shall be provided to render a level and smooth surface under the full length of the bearing surface of the curb. Curbs shall be constructed to recognize the roof slope and render the top of the curb flat and plumb in each direction.
- B. Construction: Duct support rails shall be 18 gauge galvanized steel of monolithic construction with integral base plate, continuous welded corner seams, factory-installed treated wood nailers, 1-1/2" thick 3 PCF density fiberglass insulation adhered to inside of the walls, and 24 gauge galvanized steel counter flashing. Overall height of curbs shall be no less than 16".
- C. Roof Penetrations: Provide sheet metal rain caps and counter-flashing for ductwork extending through curbs. The rain cap and counter-flashing shall be constructed of 24 gauge galvanized

sheet steel with seams soldered or brazed, or continuously welded stainless steel. The exposed surface of the rain cap, if not stainless steel, shall be bitumastic coated for a completely watertight installation. Counter-flashing shall be securely clamped directly to the ducts by means of a flashing collar to form a watertight seal. Exterior insulation and duct weatherproofing jacket shall be installed over top of counter-flashing. Thoroughly seal where insulation terminates. The underside of the rain cap shall be insulated by adhering 2" thick, 3 PCF density glass fiberboard insulation to interior surface.

- D. Fasteners and other hardware used to fasten duct supports or curb caps to wood nailers shall be stainless steel or hot dipped galvanized steel, with neoprene backed washers.

2.8 RECTANGULAR DUCT FABRICATION – GENERAL REQUIREMENTS

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" (3rd Edition; 2005), except as modified by this Section. Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Transverse joint types are limited to the following:

- a. T-1 through T-14 as shown in Figure 2-1, "Rectangular Duct/Transverse Joints" in the above referenced SMACNA standard, for ductwork in the 1/2" or 1" w.g. (positive or negative) pressure classes.
- b. Flanged duct connector systems as elsewhere specified in this Section.
- c. Joint types explicitly specified elsewhere in this Section.

2. Longitudinal joint types are limited to joint types shown in Figure 2-2, "Rectangular Duct/Longitudinal Seams" in the above referenced SMACNA standard, except for L-2 (button punch snap lock) and L-3 (grooved seam), which are not permitted. Joint types explicitly specified elsewhere in this Section are also permitted.

- B. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

- C. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359-inch-thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

2.9 FLANGED DUCT CONNECTOR SYSTEMS

- A. A pre-fabricated flanged duct connector system is acceptable for forming transverse joints on rectangular and round ductwork where the specified pressure class can be met, and subject to other restrictions herein indicated.

- B. The system shall consist of factory-fabricated add-on flange connectors, gaskets, and related components and fasteners. Materials shall be galvanized steel to match the connecting ductwork.

The system shall be suitable for ductwork having pressure ratings from +2 inches w.g. to +10 inches w.g. and from -2 inches w.g. to -10 inches w.g. The system flanges and corner pieces shall form a flange frame around the full perimeter of the duct, and shall be designed to produce a sealed fit onto a plain duct end using an integrated sealant pocket.

1. 'Formed-on' style flanges, such as SMACNA joint types T-25a and T-25b (TDC and TDF type flanges, respectively) and similar joining methods using a flange that is formed directly from the duct end and secured in place with corner connectors, are also acceptable.
 2. Corners shall be jointed using corner clips or a bolted connection.
- C. The duct connector system shall be applied in full conformance with the system manufacturer's installation instructions and with all required screws, sealants, gasket tape, corner clips, bolts, nuts, washers, and spring clip / cleats. Systems that do not use spring clips are not acceptable.
1. Substitution of zip screws for the recommended galvanized steel spring clips (cleats) is not permitted. Spring clips shall be of the length, gauge, and quantity recommended by the system manufacturer.
- D. Flange Gaskets: Permanently flexible butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
1. Comply with UL 723 and meet Mil-C 18969B and TTS-S-001657. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth.

2.10 SHOP APPLICATION OF LINER

- A. General: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," 2005, Figure 7-11, "Flexible Duct Liner Installation."
1. For round ducts, where the referenced SMACNA standard does not address the unique requirements of lining round and oval ductwork, the liner manufacturer's recommendations shall be followed.
- B. Adhere a single layer of indicated thickness of duct liner with 100 percent coverage of adhesive at liner contact surface area. Insulation shall be adhered directly to clean, oil-free surfaces. Multiple layers of insulation to achieve indicated thickness are prohibited.
- C. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.
- D. Butt transverse joints without gaps and coat joint with adhesive.
- E. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- F. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

- G. Secure liner to rectangular ducts with mechanical fasteners (weld pins and washers) 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - 1. Fan discharge.
 - 2. Intervals of lined duct preceding unlined duct.
 - 3. Upstream edges of transverse joints in ducts.
- I. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.11 ROUND DUCT FABRICATION

- A. Round Ducts: Fabricate ducts with standard spiral lock seams according to Figure 3-2 of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 2005 (3rd Edition).
 - 1. Snap-lock, lapped and riveted, butt weld, and grooved type longitudinal seam construction is not acceptable.
- B. Transverse Joints Between Duct Sections and to Fittings: Fabricate according to Figure 3-1 of the above referenced SMACNA standard.
 - 1. Ducts up to 20 Inches in Diameter: Factory fabricated slip-on gasketed flange system or type 'RT-1' beaded sleeve joint consisting of an interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts 21 to 72 Inches in Diameter: Factory fabricated slip-on gasketed flange system or a type 'RT-2' Van Stone joint consisting of a gasketed, flanged joint with two internal flanges formed on the duct end, two exterior flanges, and flange hardware.
 - 3. Ducts Larger than 72 Inches in Diameter: Type 'RT-2A' companion angle flanged joints.
 - 4. Gasketed Push-On Joints (all sizes): Refer elsewhere in this Section for requirements for round duct joint O-ring seals:
 - a. Round Ducts: Factory-fabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - 5. Draw-band, crimp joint sleeve, swedge bell, and outside sleeve joints are not acceptable.

2.12 ROUND FITTING FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," 2005, with metal thicknesses specified for spiral lock seam straight duct.

- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed (stamped), gored (segmented), or pleated construction. Single-mitered and adjustable type elbows are not permitted on round ductwork. Fabricate with a centerline bend radius of at one and one-half times elbow diameter. Fabricate elbows as follows:
 - 1. Round Elbows, 12 Inches and Smaller: Fabricate die-formed elbows for 45- and 90-degree elbows, and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
 - 2. Round Elbows, Larger than 12 Inches: Fabricate gored (segmented) elbows. Maximum 22.5 degree change in direction per segment (e.g. this requires a 5-segment elbow for a 90 degree change in direction, and elbows with less than 90-degree change of direction shall have proportionately fewer segments.).
 - 3. Die-Formed Elbows for Sizes through 8 Inches and All Pressures: 0.040-inch-thick with two-piece welded construction.
 - 4. Round Gored (Segmented)-Elbow Metal Thickness: Same as non-elbow fittings specified above.
 - 5. Pleated Elbows for Sizes through 12 Inches and Pressures through 10-Inch w.g: 0.028 inch.

2.13 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General: Comply with Chapter 8 (Double Wall Duct Construction) of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" (2005).
- B. Inner Duct (liner): Fabricate inner ducts with dimensions indicated on the Drawings, of minimum 0.028-inch thick solid sheet constructed from aluminum.
 - 1. Provide a poly sheeting complying with the requirements of UL 181, Class 1 between the interstitial insulation and the perforated liner.
- C. Outer Duct Wall: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" (2005), based on indicated static-pressure class unless otherwise indicated. Outer duct shall be aluminum for interior duct and aluminum for exterior duct.
- D. Interstitial Insulation: No less than 2-inches thick for interior duct and 4-inches thick for exterior duct, comprised of fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg. F at 75 deg. F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
- E. Transverse Joints: Flanged duct connector systems, as specified elsewhere in this Section. Flanges shall be factory-installed.

1. Inner liner shall completely enclose the interstitial insulation and shall be tack welded to the outer shell at each duct joint.
- F. Longitudinal Seams: Pittsburgh lock.
- G. Exterior Installation: Where double wall ducts are installed outdoors, comply with the following additional requirements:
1. Construct outer duct of minimum 18 gauge aluminum or 20 gauge stainless steel.
 2. The insulation thickness shall be no less than 4" for a minimum of R-12 insulating value.
 3. Duct shall be oriented with the top of the duct set at a minimum 1/2" per foot slope (i.e. 4%, or 2.5 degree angle) in the direction of the width of the duct, to prevent ponding of water on the duct surface.
 4. Only stainless steel fasteners shall be used.
 5. After making up all joints, ducts shall be additionally sealed to seal class "A" (all seams and joints and penetrations shall be fully sealed) using an exterior polymeric rubber type sealant; McGill Airflow LLC 'Uni-Weather', Ductmate Industries 'SOLVseal', or approved equal.
 6. Flanged connector system joints shall be made with a full-length cleat on all four sides of the duct so that the gap between flanges is not visible / exposed.
 7. Galvanizing Repair: Where duct galvanizing is damaged or raw edges are exposed, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.

2.14 DOUBLE-WALL ROUND AND OVAL DUCTWORK

- A. Factory fabricated round and oval double-wall pre-insulated ductwork. Ducts shall be formed with a spiral lock-seam, except where longitudinal seam is required to meet structural or material gauge requirements. Ducts shall also comply with Chapter 8 (Double Wall Duct Construction) of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" (2005).
1. Duct sections and fittings shall have solid aluminum liners. The outer pressure sheet and the inner liner shall be manufactured from aluminum or Type 304 stainless steel in the gauges recommended by the duct manufacturer. Dimensions noted on Drawings shall be interpreted at indicating diameter or length of major and minor axes of the inner metal liner.
 2. Insulation thickness shall be 4 inches, with a density no less than 1.0 lb./cu. Ft. The insulation shall provide a thermal conductivity "k" factor of no more than .27 Btu/Hr./Sq. Ft./Deg. F. at 75 Deg. F. mean temperature.
 - a. Provide a poly sheeting complying with the requirements of UL 181, Class 1 between the interstitial insulation and the perforated liner.
 3. The construction shall have mechanical means to maintain positive concentricity of liner with shell and mechanical means to retain insulation against dislocation by assembly processes. Connections shall be made with factory fabricated couplings.
 4. Provide adapter fittings at termination of double wall duct installations.
 5. Paint exposed ductwork colors as selected by the Engineer/Owner.

6. Fittings shall be generally as described above in the article titled " Round and Flat-Oval Fitting Fabrication", but of double wall construction.
- B. Exterior Installation: Where double wall ducts are installed outdoors, comply with the following additional requirements:
1. The outer shell shall be constructed of minimum 18 gauge aluminum or 20 gauge stainless steel.
 2. The insulation thickness shall be no less than 4" for a minimum of R-12 insulating value.
 3. Flat-oval duct shall be oriented with the flat portion of the top of the duct set at a minimum 1/2" per foot slope (i.e. 4%, or 2.5 degree angle) in the direction of the width of the duct, to prevent ponding of water on the duct surface.
 4. Only stainless steel fasteners shall be used.
 5. After making up all joints, ducts shall additionally be sealed to seal class "A" (all seams and joints and penetrations shall be fully sealed) using an exterior polymeric rubber type sealant; McGill Airflow LLC 'Uni-Weather', Ductmate Industries 'SOLVseal', or approved equal.
 6. Transverse joints shall be made with the Ductmate 'SpiralMate' system, or approved equal. A full-length / diameter cleats or clamping rings shall be used so that the gap between flanges is not exposed / visible on the sides and top of the duct. Minimize the number of cleat-to-cleat butt joints, and seal the butt joints with the above-described sealant.
 7. Galvanizing Repair: Where duct galvanizing is damaged or raw edges are exposed on galvanized steel, repair with a cold galvanizing repair compound with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20, as manufactured by ZRC Products Company, or equivalent.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Refer to Division 23 Section "Common Work Results for HVAC" for definitions of 'conditioned' and 'unconditioned' spaces.
- B. Select and construct and seal duct systems components (ducts, fittings, and accessories) in accordance with the following SMACNA Static-Pressure and Seal Classes. The pressure ratings indicated are minimum values:
1. Ducts Located in Interior Conditioned and Indirectly Conditioned Spaces: Unless otherwise indicated, construct ducts to the following:
 - a. Multiple Zone VAV Supply Ducts Upstream of Zone Dampers: + 4-inch w.g., Seal Class "A".
 - b. Multiple Zone VAV Supply Ducts Downstream of Zone Dampers: + 2-inch w.g., Seal Class "A".
 - 1) Exception: Where exposed in the space served, Seal Class "B" may be followed.

- c. Return and Relief Air Ducts: - 2-inch w.g., Seal Class "C".
 - d. Transfer Air Ducts: +1/2-inch w.g., Seal Class "C"
 - e. Exhaust Air Ducts: -2-inch w.g., Seal Class "B".
2. Ducts Located in Interior Unconditioned Spaces: Unless otherwise indicated, construct ducts to the following:
 - a. As specified above for ducts located Interior Conditioned Spaces, except that all ducts listed above to receive Seal Class "C" shall be provided with Seal Class "B" instead, and all ducts listed above to receive Seal Class "B" shall be provided with Seal Class "A" instead.
 3. Ducts Located at the Exterior of the Building: Unless otherwise indicated, construct ducts to the following:
 - a. As specified above for ducts located Interior Conditioned Spaces, except that all ducts shall receive Seal Class "A".
- C. Material Application: All ducts shall be galvanized steel.
- D. All ducts shall be single wall. except as follows:
1. Where ducts are indicated as double wall on the Drawings.
 2. At the contractors option: in lieu of otherwise specified Exterior ductwork.
 - a. At the Contractor's option, in lieu of providing double wall exterior ductwork as specified in this Section, the Contractor may provide ThermaDuct™ and ThermaRound™ ductwork systems. These ductwork systems shall be constructed form rigid closed cell phenolic board insulation with an FSK vapor barrier liner and an integral 1000 mil thick UV-stable vinyl or 0.032"-thick aluminum cladding on the exterior surface. The ductwork shall be constructed in accordance with the latest edition of the SMACNA Phenolic Duct Construction Standards (ANSI/SMACNA Standard 022). The insulation shall provide no less than R-12 thermal resistance with a full thermal break design, and shall be suitable for an internal temperature range from -15 deg. F. to 185 deg. F. and up to 5,000 fpm airflow velocity. The ductwork shall be UL 181 listed as a Class I air duct. Transverse field joints shall utilize a flanged and gasketed connection, and shall be finished over a with factory insulation and cladding kit. Longitudinal joints shall be factory-made. Integral, internal reinforcement provided as required to meet the specified pressure class. The top of the ductwork shall be designed to shed water. The exterior ductwork shall be a single source installation, with all fittings and flanged duct connectors furnished by ThermaDuct™, and the ductwork system shall be provide with a manufacturer's 10-year warranty against mechanical failure and water intrusion. The system shall be installed in strict compliance with the manufacturer's recommendations. The ductwork shall meet all other requirements specified in this Section for the exterior ductwork, including pressure and leakage class performance ratings and fitting type requirements. Rectangular elbows shall be fitted with turning vanes. The Contractor shall solicit instruction from the local ThermaDuct™ representative regarding the proper installation of the ductwork system prior to installation. The representative shall also visit the project site no less than once during the exterior duct system

installation, and the representative shall issue a written report regarding their observations and findings. This report shall be submitted to the Architect/Engineer as an informational submittal.

- 1) Subject to compliance with requirements, the 'Dual-Tech' ductwork system as manufactured by PTM Manufacturing LLC may be provided for rectangular ducts shown on the Drawings in substitution for the above-specified rectangular Therma duct™ ductwork system.]

3.2 DUCT FITTING APPLICATIONS

A. Elbow Configuration: Unless explicitly noted otherwise on the Drawings, use the following elbow types:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows", as modified below. NOTE: All radii listed below are to the centerline of the duct, in the plane of change of direction.
 - a. Supply ducts downstream of terminal units, exhaust and return ducts upstream of terminal units, and constant volume ducts, and duct systems lacking in terminal units and air valves:
 - 1) Radius Type RE 1 with minimum 1.5 centerline radius-to-duct width (r-to-dw) ratio.
 - 2) Radius Type RE 1 with minimum 1.0 r-to-dw ratio.
 - a) These are only permitted where a 1.5 r-to-dw elbow is demonstrated to not possibly fit in the available space by way of the ductwork shop drawing and coordination drawing review and approval process.
 - 3) Mitered Type RE 2 with small single-wall vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, 2005" Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - b. Supply ducts upstream of terminal units, return and exhaust ducts downstream of terminal units and air valves:
 - 1) Radius Type RE 1 with minimum 1.5 centerline radius-to-duct width (r-to-dw) ratio.
 - 2) Radius Type RE 3 with minimum 1.0 r-to-dw ratio and splitter vane(s) complying with Chart 4-1 and Figure 4-9 of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition (2005)".
 - a) Ducts less than 12" wide: Provide 1 splitter vane.
 - b) Ducts from 12" to 36" wide: Provide two (2) splitter vanes.
 - c) Ducts wider than 36": Provide three (3) splitter vanes.

- 3) Mitered Type RE 2 with small single-wall vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition (2005)" Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- c. All other elbow types (e.g. RE 4 un-vaned square/mitered ells, RE 5, 6, 7, 8, 9, or 10 ells, and square throat / radius heel, etc.) are not permitted, except where explicitly shown on the Drawings.
 - 1) Exception: Type RE 4 (un-vaned and mitered) ells are permitted in transfer-air ducts, and in ducts where the peak / design velocity is less than 800 feet per minute.
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, 2005" Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio:
 - 1) 1.0 centerline radius-to-diameter ratio for 90-degree elbow. These are only permitted where a 1.5 centerline radius-to-diameter elbow is demonstrated to not possibly fit in the available space by way of the ductwork shop drawing and coordination drawing review and approval process.
 - 2) 1.5 centerline radius-to-diameter ratio for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Segmented (gored) with standing seams or welded joints. Maximum 22.5 degree change in direction per segment (e.g. this requires a 5-segment elbow for a 90 degree change in direction, and elbows with less than 90-degree change of direction shall have proportionately fewer segments.)
- B. Branch Configuration: Unless explicitly noted otherwise on the Drawings, use the following branch-to-main connection types:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry, except as indicated on the Drawings.
 - b. Rectangular Main to Round Branch: Flanged or spin-in bellmouth or conical tap.
 - 1) Where the height of the duct main is insufficient to permit a bellmouth or conical tap, provide a round-to-rectangular transition on the branch duct so that a rectangular 45 degree entry connection to the main duct can be made. The transition shall be to a height equal to the main duct height, and to a width as required to maintain equal or greater total flow area as the connecting round branch duct.
 - 2) Plain, straight (e.g. constant diameter round) taps are not acceptable.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90-Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are only permitted for new branches on existing ducts.
 - a. Conical tap, 90-degree tee with oval-to-round tap, or 45-degree lateral tap. Plain taps are not permitted.
- C. Rectangular Duct Divided Flow Branches: Type 1 or 2 of the referenced SMACNA Standard.
- D. Vertical and Horizontal Offsets: Full duct dimensions shall be maintained. Use a pair of elbows complying with the above provisions. Elbows with the smallest number of degrees of change in direction that will possibly fit in the available space shall be used. Offset types shown the referenced SMACNA Standard are not acceptable.
- E. Transitions: Changes in duct sizes shall be made with uniformly sloping transitions.
 1. Transitions from a larger to a smaller duct in the direction of flow in either duct depth or height shall have not more than a 45 degree angle parallel to the airflow for a one sided transition, or 22.5 degree angle for a two sided transition (i.e. 22.5 degrees on each side, for 45 degrees total).
 2. Transitions from a smaller duct to a larger duct in the direction of flow in either duct depth or height shall have not more than a 30 degree angle parallel to the airflow for a one sided transition, or 15 degree angle for a two sided transition (i.e. 15 degrees on each side, for 45 degrees total).
- F. Goosenecks: Comply with Figure 6-5 of the referenced SMACNA Standard with the following revisions and additional requirements:
 1. Minimum curb heights shall comply with the curb height specified elsewhere in this Section.
 2. The bottom of the gooseneck opening shall be no less than 24" above the finished roof surface for air outlets, and no less than 36" above the finished roof for air intakes.
 3. The angle of rotation of the gooseneck shall be 180 degrees for air intakes.
 4. The birdscreen shall be 1/2" stainless steel wire cloth-mesh. Wire gauge shall be 14 (0.080 inches' diameter).
 5. Alternate flashing method 'B' is not permitted.
 6. The portion of the gooseneck exposed to the weather shall be constructed of minimum 20 gauge G90 steel sheet and shall be weatherproofed as specified herein for exterior, uninsulated ductwork or 18 gauge aluminum sheet with waterproofed seams.

3.3 DUCT INSTALLATION, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on shop drawings and coordination drawings.
- B. Construct and install each duct system for the specific duct pressure classification specified.

- C. Install round ducts in lengths not less than 12 feet, unless interrupted by fittings.
- D. All ductwork shall be constructed to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions. Provide additional external reinforcement to prevent visible or audible vibration of the duct walls.
- E. Install ducts with fewest possible joints.
- F. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- G. Provide SMACNA small type, single-wall turning vanes in all mitered duct elbows, except for transfer ducts and other clean air ducts with design velocities less than 750 feet per minute. Note that vanes may not be explicitly shown on the Drawings for clarity purposes only.
- H. Install couplings tight to duct wall surface with a minimum of projections into duct.
- I. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- J. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- K. Successfully pressure and leak test ductwork before applying external insulation.
- L. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- M. Where ductwork is to be lined with insulation, sizes indicated on the Drawings shall be interpreted as indicating clear dimensions inside the insulation. Adjust actual sheet metal dimensions accordingly. Shape and location of ducts may be changed to suit building conditions but cross-sectional area shall be maintained.
- N. Conceal ducts from view in finished spaces with ceilings. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- O. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- P. Electrical Equipment Spaces: Route ductwork to avoid passing through electrical equipment spaces and enclosures. Ductwork not serving transformer vaults is prohibited in such spaces.
- Q. Non-Fire- or Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions, conceal space between construction opening and duct or duct insulation with minimum 22 gauge galvanized steel sheet flanges/frames. Overlap opening on four sides by at least 1-1/2 inches and seal to wall with silicone caulk. Seal sheet metal frame to duct with duct sealant. Tightly pack the width and depth of the annular space between wall opening and duct with ASTM C 665 rock wool batt insulation, min 2.0 lbs./cu. ft. density.
- R. Exterior Wall Penetrations: Where ducts pass through exterior walls, conceal space between construction opening and duct or duct insulation with sheet metal flanges/frames. Interior flanges shall be min. 22 gauge galvanized steel, and exterior flanges shall be min. 20 gauge stainless steel.

Overlap opening on four sides by at least 1-1/2 inches and seal to wall with silicone caulk. Seal flanges to duct with duct sealant. Provide counter flashing on the top and sides of the exterior wall surface at the penetration to overlap the flanges and exterior duct waterproofing jacket min. 2". Counter-flashing shall be sealed to exterior wall construction with silicone sealant. Paint counter flashing to match the exterior color of the adjoining wall surfaces. Tightly pack the full depth and width of the annular space between wall opening and duct with ASTM C 665 rock wool batt insulation, min 2.0 lbs./cu. ft. density.

- S. Fire-Rated Wall Penetrations: Where ducts pass through interior partitions and exterior walls, install an appropriately rated fire damper. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories."
- T. Fire-Rated Slab / Floor Penetrations: Where ducts pass through discrete penetrations of fire rated slabs / floors and are not contained in a fire rated shaft enclosure, install an appropriately rated fire damper. Fire dampers are specified in Division 23 Section "Air Duct Accessories."
- U. Non-Fire-Rated Slab / Floor Penetrations: Where ducts pass through unrated floors, provide firestopping of the annular space between the duct and slab / floor opening if no rated shaft or fire damper is indicated.
- V. Fire-Rated Shaft Penetrations: Where ducts pass through a fire-rated shaft enclosure, install an appropriately rated combination fire and smoke damper. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories."

3.4 INDOOR AIR QUALITY MANAGEMENT DURING CONSTRUCTION

- A. Containment of Contaminants: The Contractor shall meet or exceed the control measures recommended by SMACNA "IAQ Guidelines for Occupied Buildings Under Construction", 2nd edition (2007) - ANSI/SMACNA 008-2008, in Chapters 3 and 4, to prevent construction dust and other contaminants from escaping the work area or contaminating new and existing HVAC systems and equipment.
- B. Protect stored on-site and installed absorptive materials from moisture damage.
- C. The Contractor shall protect new and existing duct and air system equipment (e.g. fans, AHUs, etc.) interiors from moisture, construction debris and dust, and other foreign materials. During ductwork system installation, keep open ends of ductwork and terminations at registers, grilles, zone dampers, and diffusers sealed off and closed with a polyethylene film to prevent entrance of dirt and debris. The film shall be Ductmate 'ProGuard', or approved equal. In addition, the Contractor shall take great care to thoroughly clean and wipe-down all HVAC system components and ductwork above prior and during installation.
 - 1. Comply with SMACNA "Duct Cleanliness for New Construction", 1st edition (2000), published as Appendix G of the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction", 2nd edition (2007).
 - a. Comply with the requirements of "Advanced Level" cleanliness.

2. Where new duct systems have not been wiped down before and during installation or where visual contaminants are found from a duct wipe-down observation by the Owner , or Architect/ Engineer, or Commissioning Agent after installation, the Contractor shall clean the entire ductwork system with a vacuum cleaning method in compliance with the requirements and recommendations found within NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems", 2013.
- D. HVAC System Start-Up: Delay the start-up of permanent ductwork systems until construction activities that generate large amounts of indoor or exterior airborne particulates have been completed. System startup shall be considered to be a process that involves operating the equipment and systems only as long as it necessary to verify proper operation and installation of the equipment, verification of connections, making adjustments and settings, testing controls, and conducting similar field quality control and commissioning efforts. Successful start-up does not grant the Contractor license to use the permanent systems for construction phase heating and cooling.
1. Start-up of the permanent HVAC systems shall not occur prior to all of the following being met:
 - a. The duct systems being pressure tested and fully insulated and sealed.
 - b. All filters installed, including temporary supplemental filters described below.
 - c. Completion of all drywall sanding and similar dust-generating construction activities performed inside the building, and subsequent clean-up.
 - d. Completed and functioning condensate drainage traps and piping installations.
 - e. Such time that the environmental conditions of the building under construction meet the factory warranty requirements /conditions of all installed HVAC equipment. Factory warranties and their obligations to the Owner which have been violated by the Contractor's use of equipment during construction shall become the responsibility of the Contractor for the original factory warranty duration and coverage.
 2. Temporary Supplemental Filters: Operation of the permanent systems for any purpose prior to completion of final cleaning of the building by the General Contractor shall only occur with minimum ASHRAE 52.2 - MERV 10 filter media secured and sealed to each return or exhaust air grille, register, and open ended duct inlet. Filters shall be changed weekly, or more often as needed.
 - a. Outdoor air intakes require an equivalent treatment if outdoor construction activities involve site work generating airborne dust and dirt.
- E. Temporary / Construction-Phase HVAC Services: Do NOT utilize the permanent HVAC systems, or any portion thereof, to provide construction-phase heating, cooling, ventilation, exhaust, or dehumidification required by the construction process until the permanent systems are permitted to operate continuously, and outside of the start-up process, as defined below. Temporary systems shall be provided to meet all HVAC needs prior to that time. Temporary / construction-phase HVAC shall be provided by the General Contractor, unless Division 01 indicates otherwise.
1. Substantial Completion.

3.5 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure classes and seal classes specified and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", unless more restrictive requirements are indicated in this Section.
- B. Seal and successfully pressure test externally insulated ducts before insulation installation.
- C. Seal duct seams and joints according to the referenced SMACNA standard or this Section, whichever is most restrictive / demanding:
 - 1. For ducts where Seal Class A is indicated, seal transverse joints, longitudinal seams and wall penetrations (except for damper rod penetrations).
 - 2. For ducts where Seal Class B is indicated, seal transverse joints and longitudinal seams.
 - 3. For ducts where Seal Class C is indicated, seal transverse joints only.
 - 4. Regardless of the Seal Class specified, any joint, seam, or wall penetration through which air leakage makes an audible noise at a distance of 4 feet shall be sealed till the leakage is no longer audible.

3.6 HANGING AND SUPPORTING

- A. Unless otherwise indicated or specified, install rigid round and rectangular metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - 1. Supporting ductwork and associated equipment from metal roof and floor decking is prohibited. All ductwork and associated equipment shall be supported from the building structural system.
 - 2. Ductwork shall be supported directly from the building's steel beams or from miscellaneous structural steel provided by the Division 23 Contractor bearing on steel beams.
 - 3. Loads supported by steel bar joists exceeding 100 lbs. shall be located at the joist panel points, and shall not impose an eccentric load (twisting moment). Provide supplemental steel and align direct hanger connections to the joists with the joist centerline. Connect to the upper chord of the joist wherever it is possible to do so.
 - 4. Do not drill or cut building structural steel.
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts with steel or aluminum angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet. Angles bearing on floors shall overlap the floor opening by no less than 3".
- D. Refer to Division 23 Section "Vibration Controls for HVAC" for ductwork systems requiring vibration isolation hangers and supports. Vibration isolated ductwork shall be installed such that it does not contact building structure, walls, or other building elements or work that fixed in place.

- E. Hanging ductwork from roof and floor decking in steel framed buildings is prohibited. All equipment shall be hung from building steel structural system (e.g. steel beams and joists).
1. Ductwork shall be supported directly from the building's steel beams or from miscellaneous structural steel provided by the Division 23 Contractor bearing on steel beams.
 2. Loads supported by steel bar joists exceeding 100 lbs. shall be located at the joist panel points, and shall not impose an eccentric load (twisting moment). Provide supplemental steel and align direct hanger connections to the joists with the joist centerline. Connect to the upper chord of the joist wherever it is possible to do so.
 3. Supplemental steel deflections shall be limited to length/180 of the span.
- F. Steel Cable Hanger Systems Applications and Installation: Comply with all recommendations of the cable system manufacturer. Comply with all restrictions on the use of the system imposed by the SMACNA Testing and Research Institute to ensure full conformance with SMACNA standards and recommendations. System installers shall be site-trained in the use of the materials and tools by a manufacturer's representative prior to installing materials.
1. Use only on ducts with bare metal as the exterior, finished surface (e.g. uninsulated ducts, double wall ducts, and lined ducts).
 - a. Exception: Cable hanger systems may be used on ducts with exterior insulation when used as hangers for a channel trapeze support.
 2. Select cables and end connectors so that actual loads do not exceed 1/4 of the hanger system failure load. For cables hung at angles other than vertical, apply the required de-rating factor. Space hangers no more than 12 feet apart. Confirm engagement of cable locks prior to apply the load.
 3. Apply stress distribution corner guards on rectangular duct to prevent excessive cable stress and kinking or deformation of the ductwork.
 4. Material Applications:
 - a. Use galvanized steel cables on galvanized steel ducts.
 5. Do not kink or deform cables or expose to sharp edges. Do not subject cables to a bending radius smaller than 1/4". Keep cables free of dirt, grease, and other lubricants.
 6. Do not use where the ducts are subject to dynamic loading either due to the presence of vibration or thrust force inducing equipment or asymmetrical outlet arrangements. Only use on static ducts. Restrain ducts from lateral movements using rigid hangers or by using multiple cables installed in opposing angles at a given support location (i.e. horseshoe or spread horseshoe hanger configuration). Do not use single point support methods.
 7. Do not paint cable hangers. Any hangers that have been painted shall be replaced.
- G. Rooftop Ductwork: Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements related to installation of work on the roof.
1. Rooftop ductwork shall be supported on non-penetrating prefabricated roof support rails. Minimum rail quantity and maximum spacing shall be as required to comply with herein referenced SMACNA standards and to meet the wind restraint requirements, as determined through delegated design.

2. Install roof curbs and support rails in such manner as maintain roof bond. Provide roof opening, flashing, counter-flashing, sealant, roof insulation and structural framing members.
- H. Wind Resistance and Wind Restraints and Supports for Exterior Ductwork: Wind restraints and supports shall be provided in accordance with Division 23 Section "Hangers and Supports for HVAC Piping and Equipment". Comply with the requirements of the delegated design engineer for the construction of exterior ductwork.
1. Construction of exterior ductwork, including material gauges and internal and external reinforcements, shall be sufficient to prevent damage, distortion, and movement of the ductwork between wind restraint and support locations.
 2. Exterior ductwork supports and wind restraint shall not penetrate / bridge thermal insulation or weatherproofing jackets or lagging.

3.7 CONNECTIONS

- A. Connect equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", 2005, unless detailed otherwise on the Drawings.
- C. Make ductwork connections to curb-mounted rooftop equipment by extending ductwork to the top of the roof curb. Provide a duct transition as required to terminate the duct at the top of the curb with a size matching that of the mating duct connection opening on the curb and on the equipment. Provide neoprene gasket on the mating surfaces between the duct end or curb and the equipment.

3.8 PRESSURE AND LEAKAGE TESTS

- A. Disassemble, reassemble, and seal segments of systems as required to accommodate pressure and leakage testing and as required for compliance with test requirements.
- B. Conduct tests, in presence of the Architect / Engineer, at static pressures equal to maximum design pressure of system or section being tested. Do not pressurize systems above maximum design operating pressure. Give a minimum of seven (7) days' advance notice for testing. Test for leaks before applying external insulation. Where less than 100% of duct systems are specified below to be pressure tested, the Architect / Engineer reserves the right to select the particular portions of the duct systems to be tested. Pressure-test the following:
 1. Indoor Ducts:
 - a. No less than 50% of the total duct wall area of indoor ductwork with a pressure rating +3" w.g. or higher shall be pressure tested. This percentage requirement applies individually to each separate duct system associated with a given air handling unit, fan, etc.

- 1) Exception: 100% of all ductwork located in shafts, chases, tunnels, crawlspaces, or attics shall be pressure tested, regardless of pressure class.
- b. No less than 50% of the total duct wall area of indoor ductwork with a pressure rating of -2" w.g. or lower (i.e. more negative; e.g. -4" w.g.) shall be pressure tested. This percentage requirement applies individually to each individual duct system associated with a given air handling unit, fan, etc.
 - 1) Exception: 100% of all ductwork located in shafts, chases, tunnels, crawlspaces, or attics shall be pressure tested, regardless of pressure class.
2. Outdoor Ducts: 100% of all ducts located outdoors shall be pressure tested, except for unconditioned outdoor air intake ducts that are under negative pressure.
- C. Determine leakage from entire system or section of system by relating leakage to surface area of test section.
- D. Inspect the pressurized ductwork for distortion or other physical damage that resulted from pressurizing the ductwork to the test level, and for audible leakage points. Repair and reinforce areas where physical damage occurred and seal all audible leaks, then perform a retest.
- E. Maximum Allowable Leakage:
 1. Round Ducts: Comply with requirements for Leakage Classification 4 for indoor ducts in pressure classification of 2-inch w.g. and lower, and Leakage Classification 2 for all outdoor ducts, and indoor ducts in pressure classification 3-inch w.g. and higher.
 2. Rectangular Ducts: Comply with Leakage Classification 8 for indoor ducts in pressure classification of 2-inch w.g. and lower, and Leakage Classification 4 for all outdoor ducts and indoor ducts in pressure classifications from 3-inch w.g. and higher.
 3. If a given duct test section fails, the Contractor shall:
 - a. Remake leaking joints and retest until leakage is less than maximum allowable for that test section.
 - b. Pressure-test an additional, previously untested section of ductwork that is of equal or greater surface area as the section that failed the initial pressure test. The Architect / Engineer shall select the additional duct test section(s).
- F. Leakage Test Method: Perform tests and report results according to Chapters 4 through 7 of the 2nd Edition (2012) of SMACNA's "HVAC Air Duct Leakage Test Manual" except where these specifications exceed or modify SMACNA requirements.

3.9 INSTALLATION OF INTERIOR, EXPOSED DUCTWORK IN FINISHED SPACES

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Use duct joining methods that do not rely on the use of brush-on external sealants. Utilize flanged duct connector systems, bell-spigot O-ring joint systems on round ductwork, and welded joints. On flanged duct connection systems, trim duct flange gaskets and sealants that protrude flush with the metal to create a smooth and uniform exposed bead.

- C. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets. Coordinate duct elevations and locations with the lighting and sprinkler layouts so that ductwork does not block lighting or interfere with sprinkler coverage per NFPA 13 requirements.
- D. Remove all visible shop writing, labels, etc.
- E. Hangers for round ducts shall be teardrop style strap hangers using a single threaded rod or a wire rope locking cable hanger system.
- F. Repair or replace damaged sections and finished work that does not comply with these requirements.
- G. Provide the ductwork and hangers and supports with a paint finish as specified elsewhere in this Section. Paint exposed ductwork colors as selected by the Architect.

3.10 ADJUSTING

- A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow.
- B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for detailed procedures.

3.11 DUCT CLEANING

- A. Scope: Clean existing outdoor air intake and return air ductwork being re-used under this project before testing, adjusting, and balancing, and before operating any new air handling equipment.
 - 1. Clean the existing ducts to remain before new ductwork connections.
- B. Duct Cleaning Contractor Qualifications: The duct cleaning shall be conducted by an HVAC system cleaning sub-contractor responsible to the Division 23 Contractor.
 - 1. Membership: The HVAC system cleaning sub-contractor shall be a member in good standing of the National Air Duct Cleaners Association (NADCA), or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.
 - 2. Certification: The HVAC system cleaning sub-contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
 - 3. Supervisor Qualifications: A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.
 - 4. Experience: The HVAC system cleaning sub-contractor shall submit records of experience in the field of HVAC system cleaning as requested by the Architect / Engineer or Owner.

- C. Standards: The cleaning work shall be performed in accordance with the requirements and recommendations of NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems", 2013. Level 2 containment controls shall be utilized.
1. Additionally, lined ductwork shall be cleaned in accordance with North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems," 2007.
- D. Use service openings for entry and inspection.
1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
- E. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- F. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, humidifiers, filters and filter sections, and condensate drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components and makeup air systems.
- G. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

H. Duct System Cleanliness Tests:

1. After cleaning, visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: The net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
3. Duct system will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Division 26 or 28 for duct-mounted smoke detectors.
 - 2. Division 23 Section "Instrumentation and Control for HVAC" for motor operated dampers.
 - 3. Division 23 Section "Ductwork" for duct liner.
 - 4. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator hoods.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Backdraft dampers
 - 2. Manual-balancing volume control dampers
 - 3. Life-safety dampers
 - 4. Motor operated dampers
 - 5. Single wall turning vanes and vane rails
 - 6. General duty duct-mounted access doors
 - 7. Pressure relief doors
 - 8. Instrument test holes
 - 9. Guy wires
 - 10. Flexible ducts
 - 11. Flexible connectors
 - 12. Duct accessory hardware
 - 13. Remote damper operators
 - 14. Duct silencers

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - 1. Special fittings and manual-volume-damper installations.

2. Fire-, smoke-, combination fire/smoke, and ceiling radiation damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates and Performance Data for Duct Silencers: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights. Ratings shall be made in accordance with ASTM Specification E-477, latest revision.
1. The aero-acoustic laboratory shall be NVLAP accredited for the ASTM E-477-13 or the ISO 7235 test standard. A copy of the accreditation certificate shall be included with the silencer submittals.
 2. For silencers connected to fans and fan-containing equipment, if the Contractor has submitted, or intends to submit, a fan or unit that produces higher sound levels than that of the basis of design equipment, the required silencer insertion loss shall be adjusted above those values scheduled to account for the increased sound levels of the proposed fan or unit. The Contractor is also responsible for continuing to meet the pressure drop performance scheduled. The Contractor may need to increase the cross-sectional size and/or length of the silencer to achieve the required acoustical insertion loss while also meeting the pressure drop performance, and this shall be done at no additional cost to the Owner. If the silencer selections are submitted before the fan or unit submittal, and are not adjusted for increased equipment sound power, any action taken by the Architect / Engineer on the silencer submittal is void and the silencers shall be re-selected and re-submitted once the sound levels of the alternative, proposed equipment is known. If the proposed silencers are larger in any dimension than the scheduled silencers, the Contractor shall include sufficient documentation in the re-submittal that illustrates that space is available for the installation of the larger silencers.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved. Also include locations of remote damper operators and instrument test holes for use by the Testing and Balancing Agent.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
1. NFPA 80 and NFPA 105 for testing and inspection of fire dampers, smoke dampers and combination fire/smoke dampers.

- B. Combustion Ratings. All duct accessory materials shall be equal to or less than the combustion ratings noted below when tested in accordance with ASTM E84, UL723 and NFPA 255.
 - 1. Flame Spread Classification: < 25
 - 2. Smoke Development Rating: < 50
- C. All duct accessories shall meet or exceed the SMACNA pressure class standards for the ductwork system in which they are installed, or the specified ratings, whichever are higher.
- D. Damper pressure drop and air leakage ratings shall be based on tests and procedures performed in accordance with AMCA 500-D.
- E. Duct silencer performance ratings shall be in accordance with ASTM E477, latest revision.

1.7 COORDINATION

- A. Coordinate with the General Contractor the selection and installation of life safety dampers with the architectural assemblies in which they are installed, so that the damper maintains the fire and smoke resistance of the assembly per the UL listing, and the damper can be installed in full accordance with its own UL listing.

PART 2 - PRODUCTS

2.1 DAMPERS

- A. General: The following general provisions apply to all dampers, unless noted otherwise:
 - 1. Dampers shall be rated for no less than 2,000 feet per minute (fpm).
 - 2. Dampers shall be pressure rated for no less than the system pressure to which they are connected, or the specified rating herein, whichever is higher.
 - 3. Nominal damper dimensions shall match the connecting ductwork size indicated.
 - 4. Contractor shop-fabricated dampers are not acceptable. Dampers shall be factory fabricated by one of the manufacturers listed herein.
 - 5. Dampers shall have flanged or slip end connections. 'In-duct' type installations are not acceptable.
- B. Backdraft Dampers:
 - 1. Backdraft / Barometric Relief Dampers: Factory made of minimum .050" extruded 6063-T5 aluminum blades supported on aluminum, stainless steel, or zinc plated steel rods (axles), in nylon or Celcon® bearings, set in minimum .060" 6065-T5 extruded aluminum frame. Blades shall be fitted with mechanically fastened extruded silicone or vinyl seals on contact edges to prevent noise. Aluminum and zinc-plated steel linkage hardware shall be installed in the side of the frame. Damper assembly shall be provided with an adjustable counter-balance device adjusted to assist closing or opening as indicated or required by the application. Counterweight shall permit the start of opening with as little as 0.01" w.g. differential pressure.

- a. Fans and gravity ventilators equipped with backdraft dampers shall be furnished with dampers conforming to the requirements of this specification, and shall be furnished with dampers no smaller than the full size of the connecting collar.
- b. Dampers shall be suitable for up to 3" w.g. system pressure and 2,000 fpm velocity. Provide multiple dampers mulled together to form backdraft dampers with blade widths accommodating these pressure and velocity rating requirements.
- c. Static pressure drop at 1,500 fpm face velocity shall not exceed 0.25" w.g. when tested in accordance with AMCA 500D in the 24"x24" size.
- d. Dampers shall not have a leakage rate exceeding 10 cfm/sq.ft. at 1.0" w.g. differential pressure when tested in accordance with AMCA 500D in the 24"x24" size.
- e. Damper shall be TAMCO Series '7000CW / 7000WT', or approved equal.

C. Rectangular (Manual Balancing) Volume Control Dampers:

1. Volume control dampers shall be of the factory fabricated opposed blade, multi-blade type, controlled from a single point using linkages and a manual, locking quadrant.. On insulated ducts, the quadrant shall have a minimum 2" standoff bracket (or as otherwise required to accommodate the specified insulation thickness and permit damper operation without insulation damage). Dampers shall be mounted in minimum 16 gauge roll formed galvanized steel channel frames with corner reinforcements. Blades shall be minimum 18 gauge galvanized roll-formed steel with a triple-V profile. Damper axles shall be 1/2" diameter plated steel, square or hex type, and the bearings shall be bronze or stainless steel oilite. Adjusting devices shall have locking mechanisms and shall be accessible. Damper shall be suitable for up to 2,000 fpm and 3.0" w.g. system pressure. Quadrants shall be oriented so that when the handle is parallel to the direction of airflow, the damper shall be fully open.
 - a. At the Contractor's option, for rectangular dampers no taller than 12" on systems specified with a pressure rating of 2" w.g. or less, and exposed to velocity no greater than 2,000 fpm, a single blade type damper complying with all other provisions indicated above may be provided, however the bearings (including the end bearing) are permitted to be synthetic, and the frame and blades may be as thin as 18 and 20 gauge, respectively.

D. Round (Manual Balancing) Volume Control Dampers:

1. Factory fabricated, single blade, center pivoted, constructed of galvanized sheet steel, minimum 22 gauge blade and frame for diameters up to 12", and minimum 20 gauge blade and frame for diameters larger than 12". Damper shall be controlled from a single point with a manual locking quadrant, and the opposite end shall be fitted with an end bearing support (i.e. no cantilevered dampers). On insulated ducts, the quadrant shall have a minimum 2" standoff bracket (or as otherwise required to accommodate the specified insulation thickness and permit damper operation without insulation damage). Axle shall be 1/4" square or hex shaped, plated steel, and the bearings shall be synthetic or brass. Damper shall be suitable for up to 2,000 fpm and 2.0" w.g. system pressure. Quadrants shall be oriented so that when the handle is parallel to the direction of airflow, the damper shall be fully open.

- a. For systems with a specified pressure class above 2" w.g. and up to 3" w.g., the Contractor shall provide one of the following:
 - 1) Provide a square, multi-blade damper as specified above with a pair of square to round transitions. The height and width of the square damper shall match the round duct diameter indicated.
 - 2) Provide a round damper with a pressure rating meeting or exceeding the specified pressure class of the connected duct system.

- E. Motor Operated Dampers: Provide motor operated dampers at locations indicated on the drawings. Dampers shall bear the AMCA 511 label for air leakage. The dampers shall be of the various sizes shown and shall meet AMCA leakage 1A per AMCA 511, and shall have a leakage rate not greater than 3 CFM/sq. ft. based on a pressure differential of 1" w.g. when tested in accordance with AMCA 500D. Dampers and frames shall both be of extruded aluminum construction with airfoil type blades and plated steel or aluminum damper shafts which rotate in stainless steel bushings. The drive shaft shall be extended to the outside of the section to permit connecting of damper motors. Dampers shall be provided with flexible compression type stainless steel jamb seals installed along the top, bottom and sides of the frame. Seals along each blade edge shall be EPDM or extruded silicone, suitable for operating temperatures of -50 to 250 degrees F., and installed in integral ribbed grooved inserts in blades.
 - 1. Damper motors (actuators) shall be 120-volt two-position type, spring return and directly mounted to the damper shaft. Motors shall be provided with integral thermal overload protection and a manual crank override. Damper motors shall be as manufactured by Belimo, Honeywell, Siemens, or Johnson Controls.

- F. Insulated Type Motor Operated Dampers: As described above for standard, non-insulated dampers, but the internal volume of the blades shall be filled with high density expanded foam insulation, and the blades shall have an R-value of no less than 2.3. Additionally, the frame shall be thermally broken with polyurethane resin pockets and thermal cuts. If the frame is not thermally broken, damper will still be acceptable if the damper has an AMCA Std. 500-D Thermal Efficiency Ratio of no less than 340%.
 - 1. Damper motors shall be as described above.
 - 2. Provide insulated dampers where indicated on the Drawings.

- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Backdraft Dampers:
 - a. Air Balance Inc.
 - b. American Warming & Ventilating (AWV)
 - c. Arrow United Industries, Inc.
 - d. Greenheck Fan Corp.
 - e. Ruskin Company
 - f. Pottorff
 - g. Cesco Products, Div. of Mestek Inc.
 - h. TAMCO, T.A. Morrison and Co. Inc.

2. Manual Balancing Volume Control Dampers:
 - a. Air Balance Inc.
 - b. American Warming & Ventilating (AWV)
 - c. Louvers and Dampers, Inc.
 - d. NCA Manufacturing.
 - e. United McGill Corp.
 - f. Ruskin Company
 - g. Pottorff
 - h. Cesco Products, Div. of Mestek Inc.
 - i. TAMCO, T.A. Morrison and Co. Inc.

3. Motor Operated Dampers:
 - a. Arrow United Industries, Inc. (Series AFD-20)
 - b. Greenheck Fan Corp. (Series VCD-40)
 - c. Ruskin Company. (Series CD50)
 - d. Pottorff (Series CD-51/52)
 - e. TAMCO, T.A. Morrison and Co. Inc. (Series 1500)

4. Motor Operated Dampers, Insulated Type:
 - a. Ruskin Company ('CDTI-50')
 - b. TAMCO, T.A. Morrison and Co. Inc. ('9000 BF')
 - c. Greenheck Fan Corp. ('ICD-45')
 - d. Pottorff ('TICD-52-BF')
 - e. Arrow United Industries Inc. ('AFDTI-25')

2.2 LIFE SAFETY DAMPERS

A. Fire Dampers:

1. General: Provide dynamically rated fire dampers with fusible links, where required by the 2015 International Building Code, and where indicated on the Drawings. Fire dampers shall be rated for 1-1/2 hours or 3 hours as required by the fire rating of construction in which they are installed. Fire dampers shall be UL 555 listed by a Nationally Recognized Testing Laboratory, and approved for each particular type of installation in accordance with UL, and the 2015 International Building Code. Provide dampers in accordance with UL requirements for the particular combinations on the project, and provide associated sheet metal construction in accordance with SMACNA guidelines. Fire dampers shall be accessible, with suitable means provided for replacing fusible links. Access doors shall be provided in ductwork, walls and ceilings. Provide dampers for grille access or 'out of wall' installation where indicated or required by the project conditions. Multiple dampers shall be joined together with mullions to form a damper of the required size where required and permitted by the UL listing, however dampers where both nominal dimensions are 36" or less shall be a single damper (no mulling of multiple dampers permitted).
2. Construction: Dampers shall be of the curtain type unless the multi-airfoil bladed type is required for the indicated size, or specified pressure or velocity ratings. Multi-bladed dampers, if provided, shall incorporate an external crank lever. Damper blades and frames

shall be fabricated of galvanized steel or Type 316 or 304 stainless steel. Frames shall be one piece. Closure springs shall be stainless steel.

- a. Stainless steel fire dampers shall be used where connected to aluminum or stainless steel ductwork.
3. Fusible Link Temperature Rating: Fusible links shall have temperature rating of 165 degrees F. unless specifically indicated otherwise.
4. Pressure and Velocity Ratings: Fire dampers dynamically rated for a duct velocity of 2000 FPM (minimum), and pressure levels of 4-inch w.g. (minimum), or to match duct system static pressures and velocities in which they are installed, whichever is greater. Fire dampers shall be suitable for installation in horizontal and vertical positions, as indicated on the Drawings.
5. Installation Accessories: Each fire damper shall include a sleeve and mounting angle set furnished by the damper manufacturer to ensure a UL listed installation.
6. Damper Style: Dampers shall be Type C, CR, or CO with duct transitions to match the connecting duct shape, in order to place both the damper blades and the damper frames completely out of the airstream.
 - a. Exception: Type B is acceptable where the connecting duct flow area is 4.0 sq. ft. or greater, unless indicated otherwise on the Drawings.
 - b. Exception: Type A is acceptable where a grille is installed in a fire-rated wall.
7. Sizing: Fire dampers shall have a nominal size / connection size matching the duct in which it is installed.

B. Smoke Dampers:

1. General: Provide dynamically rated smoke dampers at locations shown on the Drawings and as required to meet requirements of the 2015 International Building Code. Dampers shall be factory furnished with damper operators and the entire assembly shall be UL555S listed. Smoke dampers shall be constructed and installed in accordance with applicable requirements of the UL listing and the 2015 International Building Code. Provide dampers for grille access or 'out of wall' installation where indicated or required by the project conditions. Multiple dampers shall be mulled together where required.
2. Construction: Smoke dampers shall be parallel blade type dampers suitable for high velocity service and shall be constructed for low leakage and low pressure drop. Smoke dampers shall be furnished with a UL 555S label and NFPA 90A classified label. Damper assembly including operator shall be qualified under UL for an elevated temperature rating of 350 degrees F. The damper's UL 555S Classified leakage shall not exceed 8 CFM per sq. ft. at 4 inches w.g. (UL555S Leakage Class I). Damper frames shall be constructed of minimum 16 gauge galvanized sheet steel and the blades shall be airfoil type constructed of double skins of minimum 16 gauge galvanized steel. Damper blades shall not exceed 7 inches in width. The damper shall be UL qualified for 2,000 fpm velocity and a duct pressure of 4" w.g. Damper bearings shall be self-lubricating bronze sleeve type. Replaceable silicone rubber seals shall be installed along each blade edge in integral ribbed groove inserts in frames and blades. Compression type stainless steel seals shall be provided on top, bottom and sides of frame.

3. Damper Style: Dampers shall be Type C, CR, or CO to match duct shape, or equivalent, in order to place the damper frames completely out of the airstream.
4. Sizing: Smoke dampers shall have a nominal size / connection size matching the duct in which it is installed.
 - a. Exception: All rectangular ducts which are less than 16" in height, shall be provided with smoke dampers that are oversized by 2" in height. Provide duct transitions to match connecting duct size. Openings in smoke separations shall be oversized accordingly to accommodate the larger damper. Where it has been shown to be impossible to oversize the duct/opening, then a flat top and bottom frame style shall be used.

C. Combination Fire/Smoke Dampers:

1. General: Provide dynamically rated combination fire/smoke dampers at locations shown on the Drawings and as required to meet requirements of the 2015 International Building Code. Dampers shall be factory furnished with damper operators and the entire assembly shall be both UL555 and UL555S listed. Combination fire/smoke dampers shall be constructed and installed in accordance with applicable requirements of the UL listing and the 2015 International Building Code. Provide dampers for grille access or 'out of wall' installation where indicated or required by the project conditions. Multiple dampers shall be mulled together where required.
2. Combination fire/smoke damper assemblies shall be furnished with a UL 555S label and NFPA 90A classified label. Dampers shall utilize a parallel multi-blade type construction and bear either a 1-1/2 hour or 3-hour UL label, as required by the fire rating of construction in which they are installed.
3. Damper shall bear a UL 555S leakage classification rating of 8 CFM per sq. ft. at 4 inches w.g. (UL 555S Class I). Damper frames shall be constructed of minimum 16 gauge galvanized sheet steel. Blade construction shall be minimum 16 gauge galvanized steel, double skin airfoil blade design. Damper shall be UL qualified for a velocity of 2,000 feet per minute and 4 inches water gauge duct pressure. Blades shall be center pivoted so they can be installed for air flow in either direction. Dampers shall be qualified under UL for an elevated temperature rating of 350 deg. F. Damper bearings shall be self-lubricating bronze sleeve type. Replaceable silicone rubber seals shall be installed along each blade edge in integral ribbed groove inserts in frames and blades. Compression type stainless steel seals shall be provided on top, bottom and sides of frame.
4. Each fire/smoke damper shall be equipped with a UL classified firestat or electro-mechanical link resettable with remote or local command operation. Fusible links are not an acceptable means of heat detection. The damper shall automatically close upon detection of temperatures above 165 deg. F., or upon the detection of smoke in the ductwork.
5. Damper Style: Dampers shall be Type C, CR, or CO to match duct shape, or equivalent, in order to place the damper frames completely out of the airstream.
6. Installation Accessories: Each combination fire/smoke damper shall include a sleeve and mounting angle set furnished by the damper manufacturer to ensure a UL listed installation.
7. Sizing: Combination fire-smoke dampers shall have a nominal size / connecting size matching the duct in which it is installed.

- a. Exception: All rectangular ducts which are less than 16" in height, shall be provided with combination fire-smoke dampers that are oversized by 2" in height. Provide duct transitions to match connecting duct size. Openings in shafts and fire/smoke separations shall be oversized accordingly to accommodate the larger damper. Where it has been shown to be impossible to oversize the duct/opening, then a flat top and bottom frame style shall be used.

D. Actuators:

- 1. General: Actuators for smoke dampers and combination fire/smoke dampers shall be factory furnished complete with linkages, extended shaft and damper actuators externally mounted (i.e. out of the airstream). Dampers shall be of the direct mount type. Only where direct coupling is impossible due to space constraints or geometry of damper installation shall linkages be employed. Linkages shall be designed specifically for the actuator. Actuators shall be UL 873 or UL 60730 listed.
 - a. Internal mounted actuators shall be utilized in the following cases. Such cases shall be demonstrated by the Contractor to the satisfaction of the Architect / Engineer prior to utilizing an internally mounted actuator. Each internally mounted actuator proposed by the Contractor requires pre-approval by the Architect / Engineer:
 - 1) Where insufficient space exists to install and service an externally mounted actuators.
 - 2) Where the penetration is of rated exterior wall or slab and installation and service access to the actuator from the inside of the building has been demonstrated to be impractical, and no NEMA 3R or 4x actuators are available.
- 2. Construction: Actuators shall be electric (120 volt) with gear trim submerged in oil and sealed in steel or plastic case. Actuators shall be tested under UL 555S at 20,000 cycles. Actuators and the associated damper shall be suitable for elevated temperature service and shall be UL 555 and 555S listed at an elevated temperature rating of 350 degrees F. Actuators shall be suitable for continuous exposure of up to 120 deg. F. Actuator shall drive open in 15 seconds or less, and spring close in 15 seconds or less at elevated temperature. Actuators shall be UL 2043 listed for low smoke generation in ducts and plenums. Actuators shall have electronic or microcontroller-based motor control providing electronic cut off at full open so that no noise is generated while holding open, and shall have overload protection so that the actuators are incapable of burning out if stalled before reaching full rotation. The noise level of the actuator when holding the open position shall be inaudible. The actuators shall be directly coupled and employ a steel toothed cold-weld V-bolt clamp for connecting to damper shafts. Aluminum clamps or set-screw attachment are not permitted.
- 3. Manufacturer's Warranty: 5 years.

2.3 SINGLE WALL TURNING VANES AND VANE RAILS

- A. Turning vanes shall be installed at each mitered elbow of all square or rectangular ductwork, and shall be of sizes to suit ductwork. Vanes shall be set in factory-fabricated vane rails. Turning

vanes and vane rails shall be aluminum, stainless steel, or galvanized steel, and shall match the ductwork material in which they are installed.

- B. Turning vanes shall be of the single wall (single-thickness) type, with hemmed ends on the upstream side, and lacking extended trailing ends. Turning vanes shall be factory- or shop-fabricated in accordance with Figure 4-3 and Figure 4-4 of the SMACNA "HVAC Duct Construction Standards, Metal and Flexible", 3rd edition (2005). Vane material shall be no less than 0.029-inch thick (22 gauge), and shall be suitable for no less than 2,500 feet per minute air velocity. Use SMACNA "Small" vanes (2" radius at 1.5" spacing) for all duct widths. For vanes longer than 36", install in multiple sections with the runners fastened together, or provide a tie rod secured to the vanes at mid-span.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. C.L. Ward LLC
 - 4. Sheet Metal Connectors Inc.

2.4 DUCT ACCESS DOORS

- A. General Duty Duct Access Doors: Furnish and install access doors and frames to permit inspection, operation and maintenance of devices concealed behind the sheet metal work. Provide duct access doors of insulated double wall construction, not less than 24 gauge, galvanized steel. Provide doors and frames constructed of aluminum or stainless steel, in lieu of galvanized steel, where required to match the ductwork. Insulation shall be 1-1/2 PCF fiberglass, no less than 1" thick. Where ducts are uninsulated, insulation in access doors may be omitted.
 - 1. Light Duty Doors: Systems specified for 2" w.g. and SMACNA Seal Class B or C, or lower, shall utilize a double-cam or piano hinge-and-cam, square-framed access door. Doors may be either factory-fabricated or shop-fabricated. Doors shall be fitted with foam rubber gaskets around their entire perimeter, at both the door to frame junction, and where the frame meets the duct wall. Frames shall be secured to the duct using bend-back tabs and sheet metal screws.
 - a. Construct doors in accordance with Figure 7-2 of the SMACNA "HVAC Duct Construction Standards, Metal & Flexible" Third Edition (2005).
 - b. Sizing: Provide duct access doors no smaller than 18" x 18". Provide ducts smaller than 20" in height with access doors two (2) inches less in height than the height of the duct. In such cases, the length of the door shall be 18".
 - c. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Arrow United Industries
 - 2) Ductmate Industries
 - 3) Duro Dyne Inc.
 - 4) Flexmaster USA
 - 5) Pottorff

- 6) Ruskin
- 7) Ward Industries; a Div. of Hart and Cooley Inc.

2.5 ACCESSORY HARDWARE

- A. Fasteners and other hardware used to fasten duct accessories that penetrate duct walls shall utilize gasket-backed sealing washers.
- B. Instrument Test Holes: Cast iron, cast zinc alloy, cast bronze, or cast aluminum to suit duct material, including cap, base flange with screw holes and adhesive-backed gasket. Size (diameter) to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness. The cap shall screw-on, or shall use an expansion mechanism. Coordinate quantities and locations with the Testing, Adjusting and Balancing Agent.
 1. Screw fasteners shall be galvanized on galvanized steel ducts.

2.6 FLEXIBLE CONNECTORS

- A. General: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84 or UL723. Connectors shall be suitable for a pressure range of no less than +10 w.g. to -10 w.g.
- B. Metal-Edged Connectors: Factory fabricated with a strip of minimum 3 inches wide fabric attached using a double fold offset seam to two (2) strips of minimum 3-inch-wide, min. 24 gauge G-90 galvanized or Type 304 stainless sheet steel, or min. 22 gauge series 3003 aluminum sheet. Provide metal matching the connecting duct.
 1. Connectors used on round connections to fans shall have a reinforcing rib on the centerline of the fabric.
- C. Spring Links: Two brackets connected by a steel spring, and applied to prevent connector from being fully elongated or collapsed during use.
- D. Outdoor System, Flexible Connector Fabric: Woven fiberglass fabric double coated with weatherproof, white colored synthetic rubber (e.g. Hypalon, or equal), resistant to UV rays and ozone.
 1. Minimum Weight: 24 oz./sq. yd..
 2. Minimum Tensile Strength: 500 lbf/inch in the warp and 440 lbf/inch in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F.
- E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. C.L Ward LLC

4. Hardcast; a Div. of Carlisle Co.

2.7 REMOTE DAMPER OPERATORS

- A. Description: 'Bowden'-type cable system designed for remote manual (i.e. non-motorized, non-automatic) balancing damper adjustment. The actuator mechanism and guide tubing (e.g. casing or sheath) shall be constructed of stainless steel, galvanized steel, brass, or aluminum, and the cable shall be stainless steel. The controller shall consist of a self-locking work gear assembly. The regulator connected to the damper shaft shall consist of a shaft connector hub, wire stop, angle bracket, and casing coupling. The tubing and cable shall be up to 40 feet long, if required. The cable and housing shall be routed entirely outside of the airstream and compatible with manual balancing dampers specified elsewhere in this Section. Radial-type dampers furnished with the remote operator and the routing of actuator housing and cables inside the duct airstream are not acceptable.
 1. Unless indicated otherwise on the Drawings, locate the operator above the nearest accessible lay-in tile ceiling. Provide a mounting bracket and secure to the building structure, or to a wall or wall stud. Provide labeling that indicates which specific diffuser, grille, etc. is associated with the operator. Labeling shall reflect the final room numbers being used by the Owner.
 2. Where no accessible ceiling is located within 40 feet of the damper, provide a recessed, round wall or ceiling mounting cup for the operator. The cup shall be steel or aluminum and shall have a round stainless steel cover plate no larger than 3" in diameter. Coordinate the locations with the Architect and show on the ductwork shop drawings and coordination drawings. In this installation, the regulator connected to the damper shaft shall consist of a self-locking work gear assembly.
 3. Where indicated or detailed as such on the Drawings, locate the operator inside the plenum of slot diffusers with an L-shaped bracket, with access through the opening in the slot diffuser. When locating the operator, the final adjustment position of the slot diffuser pattern controller shall be considered, so that the pattern controller does not need to be moved to make adjustments to the damper.
 4. Furnish one (1) cable adjustment tool to the Owner, if the tool is proprietary.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Metropolitan Air Technology (MAT)
 2. Pottorff
 3. United Enertech
 4. Young Regulator Company

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards, Metal and Flexible", 3rd Edition (2005), except as elsewhere modified by the project Specifications or Drawings.
- B. Install duct accessories of materials suited to duct materials. Unless otherwise noted, use galvanized-steel or aluminum accessories in galvanized-steel ducts.
- C. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- D. Dampers shall be selected so their static pressure ratings are no less than that specified for the connecting ductwork, and the damper velocity rating is no less than the design velocity of the duct section in which each damper is installed.
- E. Install remote cable damper operators to provide for remote manual volume damper adjustment where the dampers are not easily accessible through a lay-in tile ceiling.
- F. Instrument Test Holes: Provide test holes at fan inlets and outlets, in locations as required to measure pressure drops across each item in the system (e.g. outside air louvers, filters, fans, coils, intermediate points in duct runs, etc.), and elsewhere on ductwork as indicated or required for airflow testing, measuring, and balancing. Coordinate with the Testing and Balancing Agent performing the work of Division 23 Section "Testing Adjusting and Balancing for HVAC", and provide the quantity and size of test holes where directed by the Agent.
- G. Set dampers to fully open position before testing, adjusting, and balancing.
- H. Install fire, smoke, ceiling radiation, and combination fire-smoke dampers according to the manufacturer's UL-approved written instructions. Dampers shall be selected so as to be fully compatible with the existing architectural assembly. Examine areas to receive dampers. Notify the Architect/Engineer of conditions that would adversely affect installation or subsequent utilization of dampers. Do not proceed with installation until unsatisfactory conditions are corrected.
 - 1. Install fusible links in fire and ceiling radiation dampers.
 - 2. Provide access panels and doors in walls, ceilings, shafts, and ducts for inspection and service access.
 - 3. Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking, bowing, or other installation error.
 - 4. Handle dampers from the frame or sleeve. Do not handle by the blades, actuator, or jackshaft.
 - 5. If any installation provision or detail on the Drawings conflicts with the damper's UL listing / installation instructions, the installation instructions shall take precedence.

- I. Turning Vanes: Provide single wall turning vanes in all mitered duct elbows, except for transfer ducts and other clean air ducts with design velocities less than 750 feet per minute. Turning vanes and vane rails shall be aluminum, stainless steel, or galvanized steel, and shall match the ductwork material in which they are installed.

- J. General Duty Duct Access Door Installation: Install duct access doors on sides or bottom of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment.
 - 1. Where rectangular access doors are installed on round ducts constructed for 2" w.g. pressure class and less, provide a rectangular tap fitting to receive the rectangular door.
 - 2. Install doors at the following locations:
 - a. Both upstream and downstream of duct coils.
 - b. Downstream of VAV terminal unit coils.
 - c. Upstream from duct filters.
 - d. At outdoor-air intake plenums. Only side mounting is permitted.
 - e. At duct drain pans for duct humidifiers. Only side mounting is permitted.
 - f. Downstream from control dampers and backdraft dampers
 - g. On discharge ductwork connected to equipment (in-line and cabinet fans, fan coil units, ducted cabinet heaters, blower coil units, water source heat pumps, ducted unit ventilators, make up air units, air handling units, etc.)
 - 1) All fans and fan-containing equipment shall have a minimum of one access door on the associated ductwork.
 - h. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
 - i. At each change in direction and at maximum 50-foot spacing.
 - j. Upstream from turning vanes.
 - k. Upstream of airflow measuring stations.
 - l. Upstream or downstream of other control devices requiring inspection.
 - m. Elsewhere as indicated or shown.

- K. Label access doors according to Division 23 Section "Identification for HVAC."
 - 1. Duct or plenum access doors for inspection and maintenance of fire, smoke, and combination fire/smoke dampers shall be labeled with letters not less than 1/2-inch in height that reads "FIRE/SMOKE DAMPER", "FIRE DAMPER", or "SMOKE DAMPER", as appropriate in accordance with the International Mechanical Code.

- L. Flexible Connector Installation: Install flexible connectors to connect ducts to vibrating equipment. Transverse connections to ducts shall be made as specified in Division 23 Section "Ductwork" for ductwork transverse joints. Connector fabric shall not be overly compressed nor placed under tension when the fan is off or when operating at maximum speed and pressure. Provide spring links and/or fan thrust restraints where required. Seal fabric at the adjoining ends by applying outdoor grade duct sealant to overlapping fabric flaps a minimum 1" wide, rolling the flaps tight together, and securing the roll with stainless steel staples penetrating both layers of fabric and sealant, spaced 1" o.c. Attach flexible connectors to ductwork and equipment duct connection collars using a slip-on flange duct connector system as specified in Division 23 Section "Ductwork".

1. Flexible connectors shall be omitted on ductwork connections to vibrating equipment in the following cases:
 - a. The equipment is rigidly supported or anchored, and is provided with internal flexible connector(s) and vibration isolators meeting the requirements of Division 23 Section "Vibration Controls for HVAC".
 2. Applications: Use indoor system connector fabric except for the following:
 - a. Where exposed to the outdoors / weather, use 'outdoor system' fabric.
 - b. environment' fabric.
- M. Provide thrust restraints for fans as specified in Division 23 Section "Vibration Controls for HVAC".

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust backdraft damper counter-balance devices to assist closing or opening as indicated or required.
- C. Adjust fire dampers for proper action.
- D. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 237438 - OUTDOOR VARIABLE AIR VOLUME AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls".
- C. General wind restraint requirements are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".
- D. Spring vibration isolation curbs are specified in Division 23 Section "Vibration Controls for HVAC".

1.2 SUMMARY

- A. This Section includes outdoor, variable air volume air conditioning units with the following major features, components, and accessories:
 - 1. Direct-expansion cooling
 - 2. Sufficient stages and turndown capacity of cooling and heating for discharge air temperature control throughout the range of system airflows and outdoor air conditions.
 - 3. Modulating gas furnace.
 - 4. Variable speed supply fans.
 - 5. Variable speed return air fans.
 - 6. Variable frequency drives for fans.
 - 7. Scroll compressors.
 - 8. 100% economizer outdoor- and return-air damper section.
 - 9. Integral, factory-packaged, temperature controls including minimum outdoor airflow measurement, building pressure based control of relief fan(s), and BAS interface.
- B. Under the base bid the unit shall be a split condensing type unit.

1.3 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each unit, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, accessories, and the following:
 - 1. Certified fan-performance curves with system operating conditions indicated.
 - 2. Certified fan-sound power ratings.

3. Certified coil-performance ratings with system operating conditions indicated.
 4. Motor ratings and electrical characteristics plus motor and fan accessories.
 5. Material gages and finishes.
 6. Filters with performance characteristics.
 7. Sound data including unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz.
 8. Dampers, including housings, linkages, and operators.
 9. Power, signal, and control wiring diagrams. Differentiate between manufacturer-installed and field-installed wiring.
 10. Microprocessor Controller (DDC) specifications to include available options and operating protocols, and full sequences of operation. Include complete data on all factory-supplied input devices wiring.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Also include wiring diagrams detailing power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct and unit layout and relationships between components and adjacent structural and mechanical elements.
 2. Structural members to which units will be attached.
 3. Roof openings.
- B. Condensate Traps: Prepare a schedule detailing the necessary trap dimensions (trap seal depth and net 'fall') for each unit, based on the predicted maximum static pressure in the cabinet at the location of each trap, including the effect of loaded filters. The schedule shall detail unit tag, unit size, appropriate trap schematic with the recommended trap dimensions, and unit supplied base rail height.
- C. Wind-Restraint Details: Detail fabrication and attachment of wind restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
- D. Field Quality Control Test Reports: Include startup report and functional testing report indicating and interpreting test results relative to compliance with specified requirements. Indicate results of startup and testing requirements. Submit copies of checklists.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.
1. Include bearing lubrication interval information specific to the fan selections of the provided units.

- B. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Factory Engineering: Except where explicitly permitted by these Specifications or the Drawings, no field- or contractor shop-modifications of the factory-engineered equipment package will be acceptable. No modifications that affect the unit's UL listing will be acceptable. No modifications made in a 3rd party factory (i.e. one other than that of the equipment manufacturer) will be acceptable.
- B. AHRI Certification:
 - 1. Comply with AHRI 210/240 and ARI 340/360 for testing and rating energy efficiencies for air conditioning units.
 - 2. Comply with AHRI 270 for testing and rating exterior sound performance.
 - 3. DX cooling coil rating shall be in accordance with AHRI-410.
- C. Comply with AMCA 320 for testing and rating sound performance of airstream fans.
- D. Units shall be factory run-tested.
- E. Indirect gas-fired furnace shall be ETL certified as a component of the unit.
- F. NEMA Compliance: Provide motors required as part of air conditioning units that are listed and labeled by UL and comply with applicable NEMA standards.
- G. UL Compliance: Comply with UL 1995.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 COORDINATION

- A. Coordinate layout and installation of air conditioning units with piping and ductwork and with other installations.
- B. Coordinate motor starting and control requirements with Division 26 and the ATC system supplier / sub-contractor.
- C. Coordinate the supply voltage and phase of motors and other electrical connections with Division 26.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. The manufacturer shall deliver products to site on a factory-installed base rail or shipping skid and ship units by truck with 10 mil poly shrink wrap enclosing the entire unit (covering unit openings only is not acceptable).

- B. Lift and support units with manufacturer's designated lifting or supporting points.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five (5) years from date of Substantial Completion.
 - 2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than ten (10) years from date of Substantial Completion.
 - 3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three (3) years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: Two (2) sets of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND BIDDING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Trane; a Div. of Ingersoll Rand - ('Performance Climate Changer' CSAA Series) - Basis of Design
 - 2. Engineered Air

2.2 GENERAL

- A. Provide horizontal air conditioning units having heating, cooling and air conditioning capacities as scheduled. The air conditioning units shall include the required sections, as indicated for each specific unit installation. Units shall be installed in accordance with the manufacturer's instructions and approved installation drawings.
- B. The Contractor's attention is directed to the limited space available and units shall be arranged for access and removal of components. Equipment must be suitable for installation in the space available, with equipment, conduit and piping located in such a manner that parts are accessible for future maintenance, repair or replacement. The units shall be provided with removable panels and access doors to accomplish the above.

- C. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation and maintenance bulletins shall be supplied with each unit.

2.3 OPERATING CONDITIONS

- A. Outdoor Ambient Temperature Tolerance Range:
 - 1. Construct the units to tolerate operation in an outdoor air temperature as high as 115 deg. F. Provide a high ambient package as required to accommodate this range. De-rating below the scheduled capacity and efficiency is acceptable at the high ambient temperature.
 - a. The outdoor ambient temperature for rating the unit capacity and efficiency shall be 95 deg. F.

2.4 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
- C. Casing Insulation and Adhesive: Comply with NFPA 90A. Minimum R-13 injected foam or fiberglass insulation.
- D. Duct Connections: Supply and return duct connections shall be made to the front/rear or side of the unit, as shown on the Drawings.
- E. Insulated Bottom: The unit shall be mounted on an elevated steel frame as shown on the Drawings, and the entire bottom of the unit shall be insulated and finished over with a sheet metal panel matching the rest of the exterior casing.
- F. Outdoor air and relief air openings shall be protected with a bird screen and rain hood or louver.
- G. Wind Resistance: The unit assembly shall be factory-engineered and tested to resist wind loads in accordance with the 2015 International Building Code and ASCE Standard 7, as per the project location, Exposure Category B, and a Building Risk Category of III, without the use of supplemental straps or hold downs.
 - 1. Units shall resist the greater of the following:
 - a. 3-Second Gust Design Wind Speed per ASCE Std. 7-2010.
 - b. 16 lb./sq. ft. multiplied by maximum area of equipment projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

2. Units that have been approved for use in Miami-Dade County, with a current NOA number, having successfully passed TAS 202 (Uniform Static Air Pressure Test), are also acceptable for meeting the wind resistance provisions above.
3. Alternative Compliance: Equipment that cannot meet the above wind resistance requirements may be acceptable if supplemental reinforcement and restraints are field-provided / field-applied to the equipment by the installing Contractor as alternative method of compliance with the specification, however such reinforcement shall meet with the approval of the Architect / Engineer, the delegated design engineer, and the equipment manufacturer. Refer to Division 23 Section, Hangers and "Supports for HVAC Piping and Equipment" for wind restraint delegated design requirements.

2.5 FANS

- A. Supply-Air Fans: Direct-Driven. Single width, single inlet backward inclined plenum fan(s); with permanently lubricated motor, and aluminum or painted-steel wheels. Bearings shall be selected for L50 life at no less than 200,000 hrs. Belt drive fans are not acceptable.
 1. Vibration Isolation: Minimum 2" static deflection spring or rubber-in-shear type isolators. Rubber-in-shear isolators are only acceptable for fans operating above 1,500 rpm design speed.
- B. Condenser-Coil Fans: Propeller type, mounted on shaft of permanently lubricated motor.
- C. Variable Frequency Drives: Pulse-width modulated; factory installed and tested to provide fan motor speed modulation. Variable speed, electrically commutated (EC) motors are acceptable in lieu of VFD driven AC induction motors.
 1. Shaft grounding ring shall be provided on all VFD driven motors larger than 3HP to provide a conductive discharge path away from the motor bearings to ground. Bearing protection rings shall be maintenance free circumferential rings of conductive micro fibers that discharge voltages to ground.
 2. Internal adjustability for the minimum speed, maximum speed, acceleration, deceleration, current limit.
 3. Self-Protection and Reliability Features:
 - a. Surge suppression.
 - b. Loss of input signal protection.
 - c. Under- and overvoltage trips.
 - d. Variable-frequency motor controller and motor-overload / over-temperature protection.
 - e. Critical frequency rejection.
 - f. Loss-of-phase protection.
 - g. Reverse-phase protection.
 - h. Motor over-temperature fault.

2.6 COILS

A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless copper tube in a stainless steel casing with equalizing-type vertical distributor.
2. Coil Split: Interlaced.
3. Air Conditioning Condensate Drain Pans: Provide cooling coil drain pan that is sufficient to contain coil condensate. Pans shall be constructed of fully welded stainless steel and shall meet the requirements of ASHRAE 62 with no un-sloped surfaces. Pans shall be minimum 2" deep and shall have a threaded nipple drain connection.
 - a. Drain pan shall be double wall with an R-value of 12 hr-ft²-°F/BTU. The entire area of the drain pan shall have this level of thermal performance.
 - b. Provide an intermediate drain pan on stacked cooling coils over 48" tall. Intermediate drain pan shall slope in a minimum of two planes toward a single drain connection. Provide copper tube downspouts to primary pan at the bottom of the unit.
 - c. Drain piping shall be constructed of HDPE pipe with socket fusion type fittings. Terminate piping over a 4-inch thick solid concrete splash block with underlying rubber pad on the roof.
 - 1) Refer to detail on the Drawings for the flexible Fernco fittings that shall be incorporated into the trap installation.

2.7 REFRIGERANT CIRCUIT COMPONENTS

A. Minimum Number of Refrigerant Circuits: Two (2).

B. Compressors: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater. Compressors shall be mounted on factory installed and engineered spring or rubber in shear vibration isolators.

1. Capacity Control: A minimum of four (4) compressors and four (4) stages of capacity control (plus 'off') shall be provided, with the minimum capacity step no more than 25% of the total unit capacity. Other acceptable configurations are:
 - a. Two (2) or three (3) compressors will be acceptable if at least one (1) of the compressors is modulating (inverter driven) / driven through a variable speed drive. The minimum capacity step shall be no more than 15% of total unit capacity.

C. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.

7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Water level sensor complying with UL 508 to provide protection against drain pan overflow by sensing a high condensate level in the drain pan, in conformance with the 2015 International Mechanical Code. The sensor shall de-energize the compressors upon detection of a high water level.

2.8 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 1. Pre-Filter: Pleated type, minimum 90 percent arrestance, and MERV 8. Minimum 2" thickness.
 2. Final Filter: 4" long pleated type, MERV 13

2.9 INDIRECT NATURAL GAS-FIRED FURNACE

- A. Indirect Natural Gas-Fired Furnaces: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54. Design shall be certified by and bearing label of CSA. Heating section shall be factory run tested prior to shipment.
 1. Burners: Forced combustion power burner constructed of Type 409 or 321 stainless steel, with electronically controlled electric spark or hot-surface igniter with flame sensor.
 - a. Burners shall be individually removable for ease of cleaning and servicing. The entire burner assembly must be easily removable with a slide-out drawer design.
 2. Heat-Exchanger: Provide drum and tube heat exchanger of free floating design manufactured from minimum 18-gauge Type 409 stainless steel, factory pressure and leak tested.
 3. Flue Collector and Drip Pan: Constructed of Type 409 stainless steel.
 4. Vent Kit: Factory venting to extend the furnace outlet no less than 18" above the top of the unit cabinet, or no less than 18" above the top of the unit outdoor air intake, whichever is higher. The termination shall prevent the entry of precipitation and debris.
 5. Power Vent: Integral, motorized direct driven centrifugal fan interlocked with gas valve with vertical extension. Fan motor shall have built-in thermal overload protection.
 6. Gas Train: Gas train shall include redundant main gas valves. Entire gas train assembly shall meet ASME CSD-1, and shall be designed to operate with gas pressures between 7" w.c. and 14" w.c. Gas control valves shall be modulating.
 7. Temperature Controls: A factory-furnished furnace controller shall operate the gas train, power vent, burners, and all other furnace components, including safety devices and interlocks.
 - a. The furnace controller shall communicate the following additional points with the DDC system through the controls gateway interface:
 - 1) Fault condition alarm to the DDC system.

- 2) Furnace operating status.
 - 3) Furnace firing rate.
- b. Furnace Turn Down: The overall furnace assembly shall have a turndown ratio of no less than 10:1 and a minimum furnace output no greater than that scheduled on the Drawings. If the furnace consists of multiple burner / HX modules arranged in parallel, at least one module shall be modulating with a minimum turndown of 5:1. Provide the necessary number of modules and degree of burner turndown on the modules so that the overall furnace assembly has a minimum air temperature rise requirement not exceeding 20 deg. F.
 - c. High Limit Controls: High temperature limit controls will shut off or restrict gas flow in the event of excessive temperatures or excessive temperature rise resulting from restricted indoor airflow or loss of indoor airflow.
8. Condensing Operation: Permitted, but not required. Where furnaces capable of condensing flue gases under any operating condition are furnished, provide the following:
- a. Pipe the furnace drain through the roof and provide a condensate neutralization trap (Neutra-Safe "Clear Tube" series, or approved equal). Pipe the outlet of the neutralization trap to the nearest acceptable indirect waste in the building. Provide a plenum-rated, hardwired condensate pump as required. Install a P-trap on the drain as recommended by the unit manufacturer.
 - b. The furnace condensate connection shall be made through the bottom of the unit and shall not be routed outdoors. Where the furnace condensate connection is made to the side of the unit, above the roof, provide 3" fiberglass insulation and aluminum jacket on the drain piping, and route through the roof with an insulated metal roof curb.
 - c. Exterior furnace drain piping shall be heat traced.
 - d. Drain piping shall be schedule 40 PVC pressure pipe with drainage pattern solvent welded fittings, and provided with 3M "Fire Barrier Plenum Wrap 5a+", Unifrax "FyreWrap 0.5 Plenum Insulation", or approved equal insulation where located in an air plenum. Apply fire plenum barrier wrap insulation to the neutralizing trap also. Piping size shall match the furnace connection size, or shall be 3/4", whichever is larger.
 - e. The Division 23 Contractor shall bear all of the above costs as well as those incurred by those of other trades / prime contractors.

2.10 DAMPERS

- A. Outdoor Air, Return Air, and Relief / Exhaust Dampers: Parallel- or opposed-blade galvanized-steel dampers with 3V type blades mechanically fastened to cadmium plated or galvanized-steel axles rotating in synthetic bushings, and set in a reinforced cabinet opening. Dampers shall have neoprene, EPDM, or extruded silicone blade seals. Unit shall have 0-100% economizer capability.
 - 1. Damper Motors: Low voltage, fully modulating, spring return.

2.11 ELECTRICAL POWER CONNECTION

- A. For the split system Basis of Design: Provide unit power as described below at both the air cooled condensing unit and the rooftop air conditioner.
1. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification.
 2. The unit shall be provided with a factory wired weatherproof control panel.
 3. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115- volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit.
 4. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection.
 5. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.
 6. Phase monitors shall be a three-phase line monitor module that protects against phase loss, phase reversal and phase unbalance, and shall also protect compressors from reverse rotation. The module shall automatically reset from a fault condition.
 7. Service Outlet: Provide a GFCI, 120V/15 amp, duplex convenience outlet, powered from the line side of the main unit disconnect. Provide a separate NEMA 3R disconnect switch for the receptacle.

2.12 FACTORY PACKAGE TEMPERATURE CONTROLS

- A. The unit shall be provided with a complete factory controls package to govern all primary unit control functions. The controls package shall utilize microprocessor based digital controls.
- B. Coordinate between the factory -provided controls and the work of the DDC system provider / sub-contractor to achieve the required control sequences of operation and make the required control points available through the building wide DDC system.
1. It is the responsibility of the bidding Contractor to coordinate the bids of various suppliers and sub-contractors in order to meet all requirements of the Contract. If a specified control feature or option is not available from the unit manufacturer as a factory installed item, the Contractor shall include in his bid the cost of field-applying controllers and devices as required to meet all specification and control requirements.
 2. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation for HVAC Controls".
- C. Basic Control Requirements: The unit shall be equipped with a complete microprocessor control system. This system shall consist of temperature and pressure (thermistor and transducer) sensors, printed circuit boards (modules), and a Human Interface Panel. The packaged DDC controller shall have volatile-memory backup. The controls shall be factory-installed and mounted in the main control panel. All factory-installed controls shall be fully commissioned (run tested) at the factory. All microprocessors, boards and sensors shall be factory mounted, wired and tested. Modules (boards) shall be individually replaceable for ease of service. The microprocessor boards shall be stand-alone DDC controls not dependent on communications with the building automation system.

1. The unit shall have a Human Interface Panel with a minimum 16-key keypad and 2-line x 40-character clear English display as standard to provide the operator with full adjustment and display of control data functions. Graphics-based displays with touchscreens are also acceptable.
 - a. The Human Interface Panel shall be mounted on the unit.
2. The microprocessors shall be equipped with on-board diagnostics, indicating that all hardware, software and interconnecting wiring are in proper operating condition. The modules (boards) shall be protected to prevent RFI and voltage transients from affecting the board's circuits. All field wiring shall be terminated at separate, clearly marked terminal strip.
3. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

D. Control Programs:

1. Unoccupied (Standby) Heating and Cooling Program: The unit shall operate with a minimum outdoor airflow rate of zero (0) cfm in such modes. Outdoor air shall only be introduced for purposes of economizer cooling.
 - a. The building automation system shall select the unit operating mode through gateway interface communications with the packaged controls.
2. Supply Air Temperature Control for Multiple Temperature Zone Unit Applications: Provide all necessary controls to operate a multizone unit from the unit discharge supply air temperature, including discharge air microprocessor controller and discharge air sensor wired to the unit controls. The microprocessor controller shall coordinate the comparative enthalpy economizer controls and dampers, and all of the available stages of mechanical cooling and heating output to maintain the discharge air temperature at the supply temperature setpoints.
 - a. The unit control package shall receive a 0-10VDC or 4-20 mA signal from the building automation system to reset the supply air dry bulb temperature setpoint.
3. Economizer Control: The unit controls shall control the economizer cycle by way of comparative enthalpy. Whenever the return air enthalpy is greater than the outdoor air enthalpy, the unit shall operate in economizer mode. Provide temperature and humidity sensors wired to the unit controller on the outdoor and return airstreams.
 - a. The economizer controls shall meet the requirements of the 2012 International Energy Conservation Code (IECC), including economizer fault detection and diagnostics.
4. (BASIS OF DESIGN ONLY) Supply Fan Speed Control (Duct Pressure Control) for Multizone Unit Applications: The unit controls shall include factory-installed and tested variable frequency drive(s) (VFD) to provide supply fan motor speed modulation. The VFD(s) shall receive a 0-10VDC signal from the unit microprocessor based upon remote

supply duct static pressure signal, which shall cause the drive to accelerate or decelerate as required to maintain the supply static pressure setpoint.

- a. The unit control package shall receive a 0-10VDC or 4-20 mA signal from the BAS for supply fan speed control.
5. Supply Fan Over-Pressure Protection: Provide high supply duct pressure limit switch and a supply fan suction low-limit switches to de-energize the unit fans in the event of ductwork or unit over-pressurization. Whenever the discharge pressure of the supply fan rises above its setpoint, or whenever the suction pressure of the supply fan exceeds its setpoint, the unit fans shall be de-energized and an alarm issued at the operator's workstation.
 6. Outdoor Air Measurement and Control: Measurement and control of the outdoor airflow rate shall meet requirements of ASHRAE 62.1- 2016 and the 2015 International Mechanical Code (IMC). An airflow measurement station shall be provided in the outside air opening to measure airflow. The airflow measurement station shall measure from as low as 40 cfm/nominal ton on up to the unit maximum (supply) airflow rate. The airflow measurement station shall adjust for temperature variations / be temperature compensated. Measurement accuracy shall be +/- 10% of reading throughout the full ventilation range of the unit. The outdoor air and return air dampers shall modulate to maintain the desired outdoor airflow rate, as measured by the airflow station in the outdoor air intake, throughout the entire range of supply fan speeds.
 - a. The building DDC system shall write to the factory control package the desired minimum outdoor airflow rate (i.e. the occupied mode outdoor airflow rate setpoint during non-economizer operation).
 - b. If an airflow measurement package is not available to be factory-furnished with the unit that meets the above requirements, a field applied airflow station shall be provided to meet this requirement, and this field applied work shall comply with the following:
 - 1) Field-install a DDC system controller to receive outdoor airflow signals and to pilot the unit dampers to maintain the required minimum outdoor airflow rate.
 - 2) The outdoor air rate shall be measured via an outdoor air intake mounted outdoor airflow measuring station. The installation of this station shall require modification of the intake louver or rain hood in order to meet all of the clearance and other installation requirements of the airflow station manufacturer. Submit the proposed modifications with the rest of the equipment submittal and confirmation that the modifications are acceptable to the unit manufacturer. Submittals lacking this information will be rejected.
 - 3) During the occupied mode, the outdoor and return air dampers shall be modulated by the DDC system controller to supply ventilation at a rate no less than the minimum outdoor airflow scheduled in the unit schedule. The desired outdoor airflow rate shall be increased above the minimum during economizer cycles, as governed by the packaged unit's temperature / integrated economizer controls. The fully integrated control of the mixing dampers between operating modes shall be seamless.
 - 4) Outdoor airflow measuring stations shall be a thermal dispersion type, Ebtron 'Advantage 3 Gold' series, Flow Monitor Corp. 'Electra-flo G5' series, or Ruskin 'TDP05k' series. Comply with all of the manufacturer's installation

and clearance requirements and recommendations to ensure accuracy of the station.

- a) Calibrated Velocity Range: 0 to 5000 fpm.
 - b) Accuracy: $\pm 5\%$ of volumetric flow reading, between 0 and 5,000 feet per minute air velocity, with a NIST traceable certificate. Temperature accuracy shall be $\pm 0.15^\circ$ F.
- E. Factory Testing: The units shall be run tested through all modes of operation while at the factory. Operational test logs shall be provided to the Architect / Engineer prior to application for payment for these units.
- F. Building Automation System Interface: Factory installed hardware and software to enable building automation system to control the system, adjust schedules and setpoints, and to display component status and alarms.
1. Provide a communication interface with building automation system to enable building automation system operator to remotely control and monitor the units from an operator workstation / web server. All control features that are available and displayed locally at unit control panel and human interface panel on the units shall be available to the building automation system.
 2. Coordinate with the DDC system supplier / sub-contractor on which specific gateway / protocol shall be provided, which shall be BACnet, LonWorks, or Modbus. Since the DDC system for the project is a competitive bid with no formal alternates for various suppliers, BACnet MS/TP shall be assumed for bidding purposes.
 3. The minimum control points integration shall include all points indicated above in this Section, in the sequences of operation, and the following:
 - a. Unit start/stop.
 - b. DDC system selection of unit operating Mode: Unoccupied (including Warm Up/Cool Down) and Occupied.
 - c. Adjusting and monitoring all factory control set points.
 - d. Detailed alarm messaging.
 - e. Monitoring supply and return fan operating status.
 - f. Monitoring variable-frequency drive operation.
 - g. Monitoring economizer cycles.
 - h. Monitoring and controlling air-distribution static pressure, building pressure, and ventilation air volumes.
 - i. Status of each compressor and condenser fan.
 - j. Furnace status.
 - k. Outdoor airflow rate.
 - l. Note: A control point shall be provided to the DDC system if indicated in any one or more of the above listed locations.
 4. Controls Integration: A representative from the unit supplier and the DDC system sub-contractor shall cooperate in the integration of the unit operation and the building control system during field installation.
 - a. The unit supplier shall provide a minimum of 6 hours of on-site factory technician time per unit supplied to assist in problem solving and integration.

2.13 MOTORS

- A. Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements for factory-installed motors.

PART 3 - EXECUTION

3.1 SHIPPING

- A. To protect equipment during shipment and delivery, all indoor units shall be completely stretch or shrink wrapped. Wrap shall be a minimum of 7 mil plastic. Pipe ends and pipe connection holes in the casing shall be capped or plugged prior to shipment.

3.2 EXAMINATION

- A. Examine areas and conditions to receive equipment, with installer present, for compliance with installation tolerances and other conditions affecting performance of air conditioning units.
- B. Examine roughing-in of piping, ducts, and electrical to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Steel Dunnage Frame-Mounted Units: Support on the structural steel frames using min. 1/2" thick (uncompressed) neoprene pads. Secure units to the steel frame in a manner that meets the required wind load ratings of the unit.
- B. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."
- C. Install units level and plumb, maintaining manufacturer's recommended service and airflow clearances.
- D. Install controls and equipment shipped by manufacturer for field installation with units.
- E. Identify units and connections according to Division 23 Section "Identification for HVAC Piping and Equipment."
- F. Arrange installation of units to provide access space around air-conditioning units for service and maintenance.
- G. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters at the time of turnover. Provide an additional set(s) of filters as described herein under "Extra Materials".

- H. Provide an allowance for one sheave and one belt change for each air conditioning unit during balancing procedures.

3.4 CONNECTIONS

- A. Install piping adjacent to units to allow service and maintenance. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Gas Piping: Comply with applicable requirements in Division 22. Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts.
 - 1. Connect supply ducts to rooftop unit with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
- C. Electrical System Connections and Grounding: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
 - 2. Provide label for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
- D. Install control and electrical power wiring to field-mounted control devices. Connect control wiring in accordance with Division 23 Section "Instrumentation and Control for HVAC".

3.5 CLEANING AND ADJUSTING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- C. Prior to startup, provide final cleaning of air handling units to remove road debris from interior and exterior of unit. The interior airstream surfaces of the unit shall be oil and grease free and wiped clean with 50-50 mix of denatured alcohol and water.
- D. Flush drain pans and traps clear of debris and dirt.
- E. Adjust initial temperature and humidity set points.
- F. Adjust damper linkages for proper damper operation.

- G. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- H. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- I. After completing system installation and testing, adjusting, and balancing the air conditioning units and the associated air-distribution systems, clean filter housings and install new filters.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing units and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air conditioning system testing, adjusting, and balancing.

3.7 STARTUP SERVICE

- A. Manufacturer's Startup Service: Engage a factory-authorized service representative to perform startup service. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Inspect for visible damage to unit casing.
 - 2. Inspect for visible damage to furnace combustion chamber.
 - 3. Inspect for visible damage to compressor, coils, and fans.
 - 4. Comb fins.
 - 5. Inspect internal insulation.
 - 6. Verify that labels are clearly visible.
 - 7. Verify that clearances have been provided for servicing.
 - 8. Verify that controls are connected and operable.
 - 9. Verify that filters are installed.
 - 10. Clean condenser coil and inspect for construction debris.

11. Clean furnace flue and inspect for construction debris.
12. Connect and purge gas line.
13. Remove packing from vibration isolators.
14. Inspect operation of relief dampers.
15. Verify lubrication on fan and motor bearings.
16. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
17. Adjust fan belts to proper alignment and tension.
18. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
19. Inspect and record performance of interlocks and protective devices; verify sequences.
20. Operate unit for an initial period as recommended or required by manufacturer.
21. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
 - a. Measure gas pressure on manifold.
 - b. Inspect operation of power vents.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
22. Calibrate sensors.
23. Adjust and inspect high-temperature limits.
24. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
25. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
26. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
27. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Relief-air volume.
 - c. Outdoor-air intake volume.
28. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.

- b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
- 29. Verify operation of failure modes. Inspect the following:
 - a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
 - c. Economizer to minimum outdoor-air changeover.
 - d. Relief- air fan operation.
- 30. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

3.8 FUNCTIONAL TESTING AFTER START UP

- A. All testing work described in this Article shall verify that the equipment and controls installation work is complete and fully functional / operational. This work is in addition to any commissioning, testing, and demonstration requirements involving the Commissioning Agent, as specified in Commissioning Sections, and shall be completed by the Division 23 Contractor and his sub-contractors and suppliers prior to beginning the formal commissioning process.
- B. Scope and Involved Parties: After installation, cleaning, start-up, and testing, adjusting, and balancing procedures have been satisfactorily completed, each unit installed shall be functionally tested.
 - 1. All problems encountered during equipment installation, start-up, and air balancing and water balancing shall be completed and debugged before functional testing may begin.
 - 2. The functional performance tests conducted shall demonstrate that each unit and system is operating according to the documented design intent, sequence of operations, and Contract Documents.
 - 3. The (installing) Division 23 Contractor, representative from the equipment supplier, and the DDC System Sub-Contractor shall cooperate in the integration of the unit operation and the building control system during field installation and functional testing.
- C. Functional Testing Procedures: The completed unit shall be tested for correct functionality in all operating modes by the above parties. The functional testing shall consist of an in-unit test of the controller, inputs, outputs, safeties, and all aspects of the sequences of operation. All operating modes (occupied, unoccupied, etc.) shall be tested, as are start-up, shut-down, restart after power failure. Proper response to failure and alarm conditions (e.g. freeze condition, low oil pressure, no flow, equipment failure, etc.) shall also be tested. Also, part of the functional test will be verification of the operation of compressor(s), fan(s), damper and valve actuators, and associated electrical components.
 - 1. The DDC System Sub-Contractor shall:
 - a. Lead the functional testing effort as part of the DDC system commissioning specified in Division 23 Section "Instrumentation and Control for HVAC".

- b. Devise the proposed test procedures in advance of the testing and distribute to involved parties.
 - c. Direct the efforts of the Division 23 Contractor and equipment supplier or manufacturer's representative during testing.
 - d. Compose and submit the functional testing report.
2. The Division 23 (installing) Contractor shall:
- a. Review the proposed tests for feasibility, safety, and equipment and warranty protection. Advise the DDC System Sub-Contractor of required modifications.
 - b. Provide technicians, instrumentation, and tools to facilitate the tests.
 - c. Operate the equipment and systems they have previously installed during the tests.
 - d. Assist in tests of equipment and systems with which their work interfaces.
 - e. Ensure that the manufacturer's representatives have made all project-specific adjustments and settings during equipment start-up to the factory controllers prior to the joint field-commissioning efforts.
3. The equipment manufacturer or supplier representative shall:
- a. Make all project-specific adjustments and settings during equipment start-up to the factory controllers prior to the joint field-commissioning efforts.
 - b. Provide a minimum of 8 hours of on-site factory technician time (time exclusive of travel to the site) per unit supplied to assist in functional testing, problem solving, and controls integration. This time shall be allocated as directed by the DDC System Sub-Contractor. The equipment representative shall anticipate that one dedicated site visit per unit installed may be required.
 - c. Refer to Division 23 Section "Instrumentation and Control for HVAC" for requirements regarding control integration responsibilities of the equipment manufacturer to the DDC System Contractor.
- D. Functional Testing Report: Report findings during functional testing. Identify testing procedures, problems encountered, corrective measures taken, and final results.

3.9 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, troubleshoot, and maintain the units. Refer to Division 01 Section "Demonstration and Training."
 - 1. Review data in the maintenance manuals.
 - 2. Schedule training with Owner, through the Architect, with at least 7 days' advance notice.

END OF SECTION 237438