CONTRACT #2112

NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION
One F.A. Orechio Drive
Wanaque, New Jersey 07465

Notice to Bidders,
Information for Bidders, Form of Bid,
Sample Contract, Technical Specifications, Exhibits A, B
Certification & Disclosure Form, Access Approval Form
Confidentiality and Non-Disclosure Agreement
Disclosure of Investment Activities in Iran
Certification of Non-Involvement in Prohibited Activities in Russia or Belarus

WSPS HVAC REPLACEMENT PROJECT

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Commissioners
of the

NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION

Prepared
July 2023

ALL DOCUMENTS CONTAINED HEREIN SHALL BE CONSIDERED PART OF THIS CONTRACT

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CONTRACT #2112

NOTICE TO BIDDERS

The NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION (the "Commission") is soliciting bids from Contractors that have expertise in HVAC system rehabilitations and boiler replacements.
As an overview explanation, the WSPS HVAC Rehabilitation project consists of repairing and replacing the components of the heating, cooling & ventilation systems that serve the Wanaque South Pump Station ("WSPS"), and includes, but is not limited to, the following items:
For a detailed description of the work please refer to the Contract Documents which include the Bid Specifications, form of Contract #2112, design drawings and technical specifications ("Contract Documents").

1. The existing boiler shall be replaced with two boilers with new flues.
2. In addition to the boiler replacement, the circulating pumps, expansion tank, piping, valving and controls which are located in the boiler room shall all be replaced. All of the unit heaters & heating air handlers located throughout the pump station shall be replaced.
3. The Air Conditioning compressor, evaporator & air handler shall all be replaced. The duct work shall be reused. Thermostats for each room shall be replaced.
4. Approximately ten (10) exhaust fans will be replaced.
5. Pipe & fittings at each unit and air handler heater on the supply and return lines shall be replaced.
6. All thermostat wiring shall be replaced.
7. Roof steel for roof mounted air handlers shall be reinforced.
8. New platform for AC Compressor shall be installed.
9. Any modifications needed to the roof penetrations, and any roof work needed to restore the roof is part of this contract. Roof integrity at completion of work is part of this contract.
10. Contractor shall be responsible for acquiring, and installing a complete and fully operating HVAC system for the WSPS.

The Contractor shall also be responsible to ensure that there is an operational HVAC system which shall provide heat to maintain a minimum of 45 degrees Fahrenheit in all spaces of the entire WSPS between the dates of November 15, 2023 through April 1, 2024. If the Contractor fails to comply with these requirements, a penalty of $3,500 per

day shall be imposed upon the Contractor for each day the HVAC system fails to maintain a temperature of 45 degrees Fahrenheit as required herein.,

As the WSPS is a facility of the North Jersey District Water Supply Commission, the project falls under the permitting jurisdiction of the Department of Community Affairs (DCA). The Commission has submitted the Design Drawings for Technical Design Review. The Contractor must obtain all applicable construction permits for the project for which the Commission will pay the permit fees.

The project will be constructed under a single prime contract. The bidder who is selected to enter into Contract #2112 (the "Successful Bidder") shall be a licensed contractor in the State of New Jersey, shall have at least 5 years' experience working on large industrial projects, hospitals, or schools installing/rehabilitating boilers and/or boiler replacement and HVAC systems. In addition, the Successful Bidder must own and maintain a local office within one hundred (100) miles of the Commission.

Sealed bids must be received before **1:30 PM THURSDAY, AUGUST 3, 2023** by the **NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION** in its offices at One F.A. Orechio Drive, Wanaque, New Jersey 07465, at which point they will be publicly opened and read for:

CONTRACT #2112 WSPA HVAC REPLACEMENT PROJECT

Bid Specifications are obtainable beginning **THURSDAY, JULY 6, 2023** through emailing Margaret M. Maddalena, the Commission's Contract Administrator, via email at mmaddalena@njdwsc.com. All bids must be made on the blank forms supplied by the Commission.

A **non-mandatory pre-bid meeting** will be held at the **Wanaque South Pump Station Conference, Room, 310 Fairfield Road, Wayne, NJ 017470 NJ 07465** at **10:00 a.m. on Friday, July 14, 2023**. While attendance is not mandatory, all bidders are **strongly recommended** to attend this pre-bid meeting and site visit. Failure to attend the Pre-Bid meeting does not relieve the Bidder of any obligations or requirements. Bidder can be held to have knowledge that would have been gained if the Bidder attended the Pre-Bid Meeting.

For the convenience of the bidders, the Commission has annexed a draft Contract herein. Please be advised that the Contract annexed hereto is a draft only, and the Commission reserves the right to alter or amend the terms set forth therein prior to the awarding of the bid.

Sealed bids for performing the work described herein will be received by the Commission and a contract awarded in accordance with the requirements of the Commission. However,

the Commission reserves the right to reject a bidder based upon a prior negative experience or upon any other grounds permitted by law.

Access Approval Forms should be submitted, via email to Security, with a copy of a photo ID, twenty-four (24) hours in advance of arrival on site. Please note, a new **Access Approval Form** must be submitted to Security for every visit to the Commission. **Access Approval Forms** may be found in (**Attachment #1**) of the Bid Package.

The Selected Contractor will be required to sign a Confidentiality and Non-Disclosure Agreement at the time of the Contract award and it shall be incorporated as an Attachment into the final Contract.

The Commission and/or its employees do not express or imply any statements regarding existing conditions beyond what may be stated herein. Bidders are required to comply with the requirements of N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27-1 et seq. and all other applicable statutes, laws or regulations concerning discrimination in employment of workers on public works projects. If awarded a contract your company/firm will be required to comply with requirements of N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27-1 et seq.

Bidders are required to submit a valid Business Registration Certificate from the State of New Jersey, Department of Treasury, Division of Revenue with their bid. Failure to submit proof of registration prior to the award of a contract shall be cause for rejection of the bid without further consideration.

Sealed Bids: Each bid submission must be enclosed in a sealed envelope addressed to:

North Jersey District Water Supply Commission
One F.A. Orechio Drive
Wanaque, New Jersey 07465
Attention: Margaret Maddalena, Contract Administrator

The information below must be clearly shown on the outside envelope of all bids:

CONTENTS: **SEALED PUBLIC BID**

BID NUMBER: #**2112**

BID TITLE: **WSPS HVAC REPLACEMENT PROJET**

BID TIME AND DATE: **1:30 P.M. – THURSDAY, AUGUST 3, 2023**

QUESTION CUT OFF DATE: **THURSDAY, JULY 20, 2023**

BIDS FORWARDED VIA OVERNIGHT SERVICES SHALL INDICATE THAT A SEALED BID CONTAINED THEREIN AND IDENTIFY CONTRACT #2112, THE COMMISSION

CONTRACT #2112

NOTICE TO BIDDERS

WILL NOT ACCEPT BIDS SUBMITTED VIA FAX OR EMAIL AND THE SAME WILL BE REJECTED.

The Commission will assume no responsibility for bids, which are not properly labeled, whether delivered by the bidder or the bidder's representative, or sent by mail or courier service. The Commission **will not** accept any bids submitted via fax or email. Bidders are advised not to call the Commission for information. All inquiries must be submitted via email to mmaddalena@njdwsc.com.

Bid Security: Each bid shall be accompanied by a certified check, cashier's check or bid bond for ten (10%) percent of the contract price (not to exceed $20,000) as a guarantee of execution of contract and the provision of performance security.

All bid securities, except the securities of the apparent three (3) lowest responsible bidders, will be, unless requested by the bidder, returned within ten (10) days after the opening of the bids (Saturdays, Sundays and holidays excepted). The bids of such bidders, other than the apparent three (3) lowest responsible bidders, shall then be considered officially withdrawn. Within three (3) days after the awarding of the Contract **and** the approval of the Contractor's Performance Bond (if required in the terms of this Contract), the bid securities of the remaining unsuccessful bidders shall be returned to them (Saturdays, Sundays and holidays excepted).

Surety's Consent: Every bid must be accompanied by the consent in writing of a surety company (or surety companies) qualified to do business in the State of New Jersey, who shall, at the time of submission of such bid, qualify as to its (or their) responsibility in an amount equal to ONE HUNDRED PERCENT (100%) of the contract price of such bid, and, furthermore, bind itself (or themselves) in such form as shall comply with the requirements of the Statutes of the State of New Jersey in respect to Bonds of Contractors on Public Works, N.J.S.A. 2A:44-143 to 2A:44-147, as amended and supplemented.

All bidders should use the Surety Consent Form provided by the Commission for the reasons stated on the bottom of the form.

New Jersey Prevailing Wage Act (N.J.S.A 34.11-56.25 et seq.): The Contractor is put on notice that it must pay all of its employees rendering service under this Contract in compliance with the prevailing wage rates promulgated by the New Jersey Department of Labor, a copy of which is on file at the Commission's Administrative Offices in Wanaque, New Jersey, and is hereby made a part of this Contract. In addition, the Contractor shall conform to all other labor laws and statutes established in this State.

Bid

All bidders are considered to have full knowledge of the conditions and requirements, including the physical characteristics of the site and the project, which are necessary for an accurate bid. The Commission assumes no responsibility with respect to ascertaining for the Bidder the facts of these physical characteristics, other than the facilitation of the Pre-Bid Meeting and Site Tour. The Bidder shall be held to be aware of the Commission's

CONTRACT #2112

NOTICE TO BIDDERS

Requirements prior to the time of submitting bids and to have appraised all conditions under which the Contract is to be performed.

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By order of the **NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION**.

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DR. HOWARD L. BURRELL
Chairman

ATTEST: **KIM DIAMOND**
Commission Secretary

BID #2112

INFORMATION FOR BIDDERS

Note: The use of the masculine herein shall include the feminine, and the use of the plural shall include the singular, and vice versa.

Form to be Used: All bids must be made on the blank form "Bid" attached hereto and in accordance with the directions on the form.

Bid in Words and Figures: The price shall be printed in ink in both words and figures. Any bid which fails to name a price both in words and in figures per unit for each and every item, wherein quantities are given, may be held to be non-responsive and may be rejected. In case of any discrepancy or conflict, the price written in words will take precedence over the price written in figures, unit prices will take precedence over price extension, and the sum of individual items, including unit prices multiplied by estimated quantities, and/or individual lump sum and/or allowance amounts will take precedence over the total bid price or alternate bid price.

Bids Not to be Withdrawn: No bid will be permitted to be withdrawn for any reason whatsoever after it has been submitted (except as permitted by N.J.S.A. 40A:11-23.3).

Sealed Bids: Each bid submission must be enclosed in a sealed envelope addressed to:

North Jersey District Water Supply Commission
One F.A. Orechio Drive
Wanaque, New Jersey 07465
Attention: Margaret Maddalena, Contract Administrator

The information below must be clearly shown on the outside envelope of all bids:

CONTENTS - SEALED PUBLIC BID

BID NUMBER: #2112

BID TITLE: WSPS HVAC REPLACEMENT PROJECT

BID TIME AND DATE: 1:30 P.M. on THURSDAY, AUGUST 3, 2023

QUESTION CUT OFF DATE: THURSDAY, JULY 20, 2023

BIDS FORWARDED VIA OVERNIGHT SERVICES SHALL INDICATE THAT A SEALED BID IS CONTAINED THEREIN.

CONTRACT #2112

INFORMATION FOR BIDDERS

The Commission will assume no responsibility for bids, which are not properly labeled, whether delivered by the bidder or the bidder's representative or if sent by mail or courier service. The Commission will not accept any bids submitted via fax or email. Bidders are also advised not to call the Commission for information. All inquiries must be submitted via email to Margaret M. Maddalena at mmaddalena@njdwsc.com.

Bid Security:

Each bid shall be accompanied by a certified check, cashier's check or bid bond for ten (10%) percent of the contract price (not to exceed $20,000), as a guarantee of execution of contract and the provision of performance security.

All bid securities, except the securities of the apparent three (3) lowest responsible bidders will be, unless requested by the bidder, returned within ten (10) days after the opening of the bids (Saturdays, Sundays and holidays excepted). The bids of such bidders, other than the apparent three (3) lowest responsible bidders, shall then be considered officially withdrawn. Within three (3) days after the awarding of the contract **and** the approval of the Contractor's Performance Bond (if required in the terms of this Contract), the bid securities of the remaining unsuccessful bidders shall be returned to them (Saturdays, Sundays and holidays excepted).

Default:

In the case of winning bidder's default, the Commission shall apply said bidder's bid security to the expenses incurred by the Commission in (i) rebidding the Contract and (ii) payment of any difference between the bid price and the price the Commission may be required to pay upon awarding this Contract to a subsequent bidder.

Surety's Consent:

Every bid must be accompanied by the consent in writing of a surety company (or surety companies) qualified to do business in the State of New Jersey, who shall, at the time of submission of such bid, qualify as to its (or their) responsibility in the amount of such bid, and, furthermore, bind itself (or themselves) in such form as shall comply with the requirements of the Statutes of the State of New Jersey in respect to Bonds of Contractors on Public Works, N.J.S.A. 2A:44-143 to 2A:44-147, as amended and supplemented, as follows:

> That upon the awarding of the said Contract to the person (or persons) making the bid, the said surety company (or surety companies) shall become surety, firstly, for the faithful performance of the said work, and secondly, for the protection of all persons performing labor, or furnishing labor or materials. Therefore, as required by law, said performance bond is to be in an amount equal to **ONE HUNDRED PERCENT (100%)** of the contract price.

All bidders should use the Surety Consent Form provided by the Commission for the reasons stated on the bottom of the form.

INFORMATION FOR BIDDERS

Payment and Performance Bond:

The Contractor to whom the Contract is awarded shall give a bond for **ONE HUNDRED PERCENT (100%)** of the Contract price in satisfactory legal form of a surety company or companies authorized to do business by and operating in accordance with the laws of the State of New Jersey, and to be approved by the Commission for the faithful performance of all provisions of the contract relating to work included in these specifications, including the safeguarding against infringement of any or all patents; and said bond to be canceled upon the performance of the conditions therein specified and upon the payment for final delivery of material under these specifications. In addition this bond shall protect all persons furnishing materials or labor to the Contractor or any subcontractors for the completion of said Contract in accordance with the laws of the State of New Jersey, and shall be in such legal form as shall satisfy the requirements of N.J.S.A. 2A:44-143 to 2A:44-147, and amendments and supplements thereto, and shall not be canceled and returned until such time as the Commission determines that all liability to any and all persons protected by the condition of said bond has been met by the Contractor or person primarily liable for the payment thereof, or by the surety (or sureties) on said bond.

Corporate Acknowledgment:

In the event that a bidder is a corporation in which all offices are held by a ***single individual***, then any documents or instruments presented to the Commission in connection with bid shall be executed by said individual only as executive officer, and said officer's signature shall be authenticated and witnessed by a Notary Public licensed to act in such capacity under the laws of the State of New Jersey. This requirement shall apply only to those corporations satisfying the "single individual" criteria set forth above.

Compliance with All Laws:

The successful bidder will be required to keep itself informed and to comply with all Federal, State, County and Local laws, ordinances, and regulations as such may apply.

Non-Collusion:

Bidders are required to give their names together with the address of their places of business. If a bidder is a corporate entity, then any affidavit submitted in conjunction with a bid for this Contract must be signed by a corporate officer. If the Commission discovers that a person or persons submitting a bid is interested, in any manner, in any other bid for the same piece of work, both bids shall be deemed nonconforming and shall be immediately rejected. This provision shall not prevent a party from quoting prices on materials or equipment to more than one bidder. Every bid to be conforming must be in all respects fair and without collusion or fraud and Bidders shall expressly represent that the Bidder is the only person interested in said bid; that it is made without any connection with any person submitting another bid for the same Contract; that the bid is in all respects fair and without collusion, fraud or mental reservation; that no official of the Commission or any person in the employ of the Commission is directly or indirectly interested in said bid or in the supplies or work to which it relates, or in any portion of the profits thereof.

INFORMATION FOR BIDDERS

Bidders will be required to submit a fully executed Affidavit of Non-Collusion as part of the bid submission.

Balanced Bidding:

Any bid which, in the opinion of the Commission, is unbalanced, may be rejected in the sole discretion of the Commission.

Authorized to Reject Bids:

The Commission reserves the right to abandon the bid process or reject all bids and re-advertise and award the Contract in the regular manner if, in its judgment, such action will best serve the interest of the Commission.

The Commission reserves the right to reject any or all bids which may be non-responsive or the acceptance of which, in the sole judgment of the Commission, may be detrimental to its interests.

The Commission also reserves the right to reject a bidder based upon a prior negative experience or upon any other grounds permitted by law.

Time within which Contract is to be Executed:

The successful bidder shall execute this Contract and give to the Commission the required security within seven (7) working days from the date that the said contract has been awarded to him. Upon failure to do so, said bidder will be considered as having abandoned this Contract.

Buy American Acts:

Any successful bidder and his subcontractors, if any, must comply with all "Buy American" statutes or regulations, including N.J.S.A. 52:33-1 et seq.

The Commission reserves the right to accept non-domestic materials under this Contract in accordance with N.J.S.A. 52:33-2 and 52:33-3 in the event: (i) it determines the use of domestic materials is "impractical" or "inconsistent with the public interest"; (ii) it determines that the cost of using domestic materials is "unreasonable"; or (iii) domestic materials of the class or kind sought are not mined, produced, or manufactured, as the case may be, in the United States in commercial quantities and of a quality satisfactory to the Commission.

Brand Name or Equivalent:

Wherever a brand name is designated in the bid documents, it shall mean “brand name or equivalent.” Bidders will be required to demonstrate, to the sole satisfaction of the Commission, that equivalent products are both compatible and effective.

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INFORMATION FOR BIDDERS

Award of Contract:

The Contract will be awarded to the lowest responsible and responsive bidder, who, in the judgment of the Commission, is qualified to do the work. The award shall be based on the total for the Base Bid (as defined herein) plus the Option (as defined herein), if selected by the Commission at the time of the award. The Commission may, in its sole discretion, determine to proceed with the project in connection with the Base Bid without including the Option. The Commission reserves the right to reject any and all bids, and to waive minor or non-material bid defects.

Worker and Community Right-to-Know Act (N.J.S.A. 34:5A-1 et seq.; N.J.A.C. 7:1G):

This Act requires employers to label all containers of hazardous substances. All goods offered for purchase to the Commission must be labeled in compliance with the provisions of this Act.

Material Safety Data Sheets also must be supplied as is required by law.

Bidder's Qualifications:

Only those bidders who are licensed contractor in the State of New Jersey and thoroughly experienced in quality work of the type required herein and in the installation of materials, as specified herein, with at least 5 years' experience working on large industrial projects, hospitals, or schools installing/rehabilitating boilers and/or boiler replacement and HVAC systems may apply.

Bidders are put on notice that their previous experience and performance record will be carefully considered prior to award of contract. Bidders must also own and maintain a local office within one hundred (100) miles of the Commission.

Interpretations and Addenda:

No interpretations of the meanings of any portion of the bid documents will be made to any prospective bidder orally. Every request for an interpretation or correction shall be made in writing addressed to **MARGARET M. MADDALENA, CONTRACT ADMINISTRATOR, NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION** and submitted via email to mmaddalena@njdwsc.com. **Requests for interpretations received later than THURSDAY, JULY 20, 2023 will be considered untimely, and, at the sole discretion of the Commission, will not be considered.** Notice of corrections and any supplemental instructions in the form of written addenda to the bid documents will be published in a legal newspaper, faxed and/or mailed to bidders at their respective addresses furnished for such purposes, certified, not later than seven (7) days (Saturdays, Sundays and Holidays excepted) prior to the date fixed for the opening of bids. The failure of any bidder to receive any such addenda or interpretations shall not release said bidder from any obligations under his bid as submitted.

All addenda so issued shall become part of the bid documents. Only the written interpretations, corrections, and addenda so given by **MARGARET M. MADDALENA,** shall

be binding, and the prospective bidders are warned that no other officer, agent or employee of the Commission is authorized to give information concerning, or to explain or interpret, the bid documents.

Each bidder is required to submit with its bid a completed ***"Acknowledgment of Receipt of Changes to Bid Documents Form"*** **(Page I-29)**, included with these bid specifications. In the event no notices, revisions, or addenda to the bid advertisement, Technical Specifications, or bid documents are received by the bidder, the bidder shall indicate ***"none"*** on that form, which must still be completed, acknowledged, signed and submitted with its bid.

Affirmative Action:

Bidders are required to comply with the requirements of N.J.S.A. 10:5-31 et seq. (P.L. 1975, c.127) and N.J.A.C. 17:27-1.1 et seq. Construction Contracts.

After notification of award, but prior to signing a construction contract, the contractor shall submit to the Commission's compliance officer and the Dept. of LWD, Construction EEO Monitoring Program an initial project workforce report (Form AA-201) electronically provided to the public agency by the Dept. of LWD, Construction EEO Monitoring Program, through its website, for distribution to and completion by the contractor, in accordance with N.J.A.C. 17:27-7. The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Dept. of LWD, Construction EEO Monitoring Program, and to the Commission's compliance officer.

During the performance of this contract, the contractor agrees as follows:

The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

INFORMATION FOR BIDDERS

The contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer, pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

When hiring or scheduling workers in each construction trade, the contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by N.J.A.C. l7:27-7.2; provided, however, that the Dept. of LWD, Construction EEO Monitoring Program, may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by the following provisions, A, B, and C, as long as the Dept. of LWD, Construction EEO Monitoring Program is satisfied that the contractor or subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Dept. of LWD, Construction EEO Monitoring Program, that its percentage of active “card carrying” members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with N.J.A.C. **17:27-7.2.**

The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:

(A) If the contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et. seq., as supplemented and amended from time to time and the Americans with Disabilities Act. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the contractor or subcontractor agrees to afford equal employment opportunities minority and women workers directly, consistent with this chapter. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities as specified in this chapter, the contractor or subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the hiring or scheduling procedures prescribed under (B) below; and the contractor or subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.

(B) If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (A) above, or if the contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor agrees to take the following actions:

(1) To notify the public agency compliance officer, the Dept. of LWD, Construction EEO Monitoring Program, and minority and women referral organizations listed by the Division pursuant to N.J.A.C. 17:27-5.3, of its workforce needs, and request referral of minority and women workers;

(2) To notify any minority and women workers who have been listed with it as awaiting available vacancies;

(3) Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;

(4) To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State Training and Employment Service and other approved referral sources in the area;

(5) If it is necessary to lay off some of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and nondiscrimination standards set forth in this regulation, as well as with applicable Federal and State court decisions;

(6) To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:

(i) The contactor or subcontractor shall interview the referred minority or women worker. If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the contractor or subcontractor shall in good faith determine the qualifications of such individuals. The contractor or subcontractor shall hire or schedule those individuals who satisfy appropriate qualification standards in conformity with the equal employment opportunity and non-discrimination principles set forth in this chapter. However, a contractor or subcontractor shall determine that the individual at least possesses the requisite skills, and experience recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Dept. of LWD, Construction EEO Monitoring Program. If necessary, the contractor or subcontractor shall hire or schedule minority and women workers who qualify as trainees pursuant to these rules. All of the requirements, however, are limited by the provisions of (C) below.

(ii) The name of any interested women or minority individual shall be maintained on a waiting list, and shall be considered for employment as described in (i) above, whenever vacancies occur. At the request of the Dept. of LWD, Construction EEO Monitoring Program, the contractor or subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.

(iii) If, for any reason, said contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Dept. of LWD, Construction EEO Monitoring Program.

(7) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Dept. of LWD, Construction EEO Monitoring Program and submitted promptly to the Dept. of LWD, Construction EEO Monitoring Program upon request.

(C) The contractor or subcontractor agrees that nothing contained in (B) above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the targeted county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to (B) above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of (B) above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

After notification of award, but prior to signing a construction contract, the contractor shall submit to the public agency compliance officer and the Dept. of LWD, Construction EEO Monitoring Program an initial project workforce report (Form AA-201) electronically provided to the public agency by the Dept. of LWD, Construction EEO Monitoring Program, through its website, for distribution to and completion by the contractor, in accordance with N.J.A.C. 17:27-7. The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Dept. of LWD, Construction EEO Monitoring Program, and to the public agency compliance officer.

The contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is necessary, for on-the-job and/or off-the job programs for outreach and

training of minorities and women.

(D) The contractor and its subcontractors shall furnish such reports or other documents to the Dept. of LWD, Construction EEO Monitoring Program as may be requested by the Dept. of LWD, Construction EEO Monitoring Program from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Dept. of LWD, Construction EEO Monitoring Program for conducting a compliance investigation pursuant to N.J.A.C. 17:27-1.1 et seq.

Patent Infringement:

No specification or specifications provided to the Contractor shall constitute a warranty, express or implied, against any claims for infringement for patents, copyrights, or trademarks and the Commission shall not be responsible to the Contractor, as indemnitor or otherwise, for or on account of any such claim or liability.

Contractor guarantees that the sale or use of its products will not infringe any United States or foreign patent, copyright, or trademark, and Contractor shall indemnify the Commission against all judgments, decrees, costs and expenses resulting from such alleged infringement, and covenants that Contractor will upon request of the Commission and at the Contractor's own expense, defend, or assist in the defense of, any suit or action which may be brought against the Commission or those selling or using any product or service of the Commission by reason of any alleged infringement of any patents, copyrights, or trademarks in the sale or use of the Commission's products of services.

Working Hours:

Contractor shall be permitted to perform work on Commission property during the hours of 7:30 a.m. to 5:00 p.m., Monday through Friday, non-holiday periods.

Time for Completing Work:

The Contractor shall commence the work within seven (7) days from the issuance of the Notice to Proceed by the Commission. The Contractor shall achieve Substantial Completion within **Three Hundred Sixty Five (365) Calendar Days** of the commencement of work.

Liquidated Damages:

If the Contractor shall not complete the work within the same time herein specified, or any proper extension thereof granted by the Commission, then the Contractor does hereby agree, as part consideration for the awarding of this Contract, to pay the Commission ***FIVE Hundred ($500.00) per calendar day***, commencing on the 31st calendar day of failure to achieve Substantial Completion, not as a penalty, but as a liquidated damages for such breach of contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the **BID** for completing the work.

The Commission may, in its sole discretion, review any purported reasons for delay and consider an extension or change order pursuant to the terms of Contract. The Commission

shall have the right to offset from monies owed the Contractor under this Contract any and all monies owed the Commission as Liquidated Damages.

Campaign Contributions and Expenditure Reporting:

In order to safeguard the integrity of the Commission's procurement process, the Commission has imposed restrictions to insulate the award of contracts from political contributions that pose the risk of improper influence, purchase of access, or the appearance thereof. The terms and conditions set forth in this section are material terms of any contract resulting from this Bid.

a. Definitions.

For the purposes of this section, the following shall be defined as follows:

(i) Contribution – means a contribution reportable by the recipient under "The New Jersey Campaign Contributions and Expenditures Reporting Act", N.J.S.A.10:44A-1 et seq., and implementing regulations set forth at N.J.A.C. 19:25-7 and N.J.A.C. 19:25-10.1 et seq. Currently, contributions in excess of $300 during a reporting period are deemed "reportable" under these laws.

(ii) Contractor – means any natural or legal person, business corporation, professional service corporation, limited liability company, partnership, limited partnership, business trust, association or any other legal commercial entity organized under the laws of New Jersey or any other state or foreign jurisdiction. It also includes (a) all principals who own or control more than ten percent (10%) of the profits or assets of the Contractor or ten percent (10%) of the stock in the case of a contractor that is a corporation for profit, as appropriate; (b) any subsidiaries directly or indirectly controlled by the Contractor; (c) any political organization organized under 26 U.S.C.A. 527 that is directly or indirectly controlled by the Contractor, other than a candidate committee, election fund, or political party committee; and (d) if the Contractor is a natural person, that person's spouse or child, residing in the same household.

b. Breach of Contract.

It shall be a breach of the terms of any contract for the Contractor to (i) make or solicit a contribution in violation of the terms of this section, (ii) knowingly conceal or misrepresent a contribution given or received; (iii) make or solicit contributions through intermediaries for the purpose of concealing or misrepresenting the source of the contribution; (iv) make or solicit any contribution on the condition or with the agreement that it will be contributed to a campaign committee or any candidate or holder of the public office of Governor, or to any State or county party committee; (v) engage or employ a lobbyist or consultant with the intent or understanding that such lobbyist or consultant would subject that entity to the restrictions of this section; (vi) fund contributions made by third parties, including consultants, attorneys, family members, and employees; (vii) engage in any exchange of contributions to circumvent the intent of this section; or (viii) directly or indirectly through or by any other person or means, do any act which would

subject that entity to the restrictions of this section.

c. Certification and Disclosure Requirements.

(i) The Commission is prohibited from entering into a contract with any Contractor for services or any material, supplies or equipment, or to acquire, sell or lease any land or building, where the value of the transaction exceeds $17,500, if that Contractor has solicited or made any contribution of money, or pledge of contribution, including in-kind contributions to a candidate committee and/or election fund of any candidate for or holder of the public office of Governor, or to any State or county political party committee: (i) within the eighteen (18) months immediately preceding the commencement of negotiations for the contract or agreement; (ii) during the term of office of a Governor, in the case of contributions to a candidate committee or election fund of the holder of that office, or to any State or county political party committee of a political party nominating such Governor in the last gubernatorial election preceding the commencement of such term; or (iii) within the eighteen (18) months immediately preceding the last day of the term of office of Governor, in which case such prohibition shall continue through the end of the next immediately following term of the office of Governor, in the case of contributions to a candidate committee or election fund of the holder of that office, or to any State or county political party committee of a political party nominating such Governor in the last gubernatorial election preceding the commencement of the latter term. Effective November 15, 2008, Executive Order No. 117 extends the above prohibition to contributions made to a candidate committee or election fund of any candidate for or holder of the office of Lieutenant Governor, and to contributions made to a legislative leadership committee or a municipal political party committee.

(ii) At the time of the submission of its Bid, a Bidder shall report all contributions the Contractor made during the preceding four (4) years to any political organization organized under 26 U.S.C.A. 527 of the Internal Revenue Code that also meet the definition of a "continuing political committee" within the meaning of N.J.S.A. 19:44A-3(n) and N.J.A.C. 19:25-1.7. **The required forms and instructions are included in this Bid Specification package (Attachment #2) and must be returned with a bidder's bid fully completed. Failure to submit the fully completed Certification and Disclosure(s) with a Bid may result in the rejection of the Bid, as well as preclude future contract opportunities.**

(iii) Further, the Contractor is required, on a continuing basis, to report any contributions it makes during the term of the Contract, and any extension(s) thereof, at the time any such contribution is made. The required form and instructions are available for review on the Purchase Bureau website at http://www.state.nj.us/treasury/purchase/forms.shtml and shall be provided to the intended awardee with the Notice of Intent to Award.

d. Disclosure Review.

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The Commission shall ensure that the completed Certification and Disclosure(s) submitted pursuant to this section, as well as any other pertinent information concerning the contributions or reports thereof by the Successful Bidder, or by the Contractor during the term of the Contract are reviewed by the appropriate authorities. If it is determined that any contribution or action by the Contractor constitutes a breach of contract that poses a conflict of interest in the awarding of the Contract under this solicitation, the Commission shall disqualify the Contractor from award of such Contract.

Business Registration Act:

A. Business Registration: Pursuant to N.J.S.A. 52:32-44, **NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION** is prohibited from entering into a contract with an entity unless the bid/proposal/contractor, and each subcontractor that is required by law to be named in a bid/proposal/contract has a valid Business Registration Certificate on file with the Division of Revenue and Enterprise Services within the Department of Treasury.

B. Prior to contract award or authorization, the contractor shall provide the Commission with its proof of business registration and that of any named subcontractor(s).

C. Subcontractors named in a bid or other proposal shall provide proof of business registration to the bidder, who in turn, shall provide it to the Commission prior to the time a contract, purchase order or other contracting documents is awarded or authorized.

D. During the course of contract performance:

(1) the contractor shall not enter into a contract with a subcontractor unless the subcontractor first provides the contractor with a valid proof of business registration.

(2) the contractor shall maintain and submit to the Commission a list of subcontractors and their addresses that may be updated from time to time.

(3) the contractor and any subcontractors providing goods or performing services under a contract, and each affiliates, shall collect and remit to the Director of Division of Taxation in the Department of Treasury, the use tax due pursuant to the Sales and Use Tax Act, (N.J.S.A. 54:32B-1 et.seq.) on all sales of tangible personal property delivered to the State. Any questions in this regard can be directed to the Division of Taxation at (609)2925-6200. Form NJ-REG can be filled out at www.state.nj.us/treasury/revenue/busregcert.html.

E. Before final payment is made under the contract, the contractor shall submit to the Commission a complete list of all subcontractors and their addresses.

F. Pursuant to N.J.S.A. 54:49-4.1, a business organization that fails to provide a copy of a business registration as required, or that provides false business registration information, shall be liable for a penalty of $25 for each day of violation, not to exceed $50,000, for each proof of business registration not properly provided under a contract with a contract agency.

Public Works Contractor Registration Act*:*

N.J.S.A. 34:11-56.48 et seq., requires that a general or prime contractor and any listed subcontractors named in the contractor's bid proposal shall possess a certificate at the time the bid proposal is submitted. After bid proposal are received and prior to award of contract, the successful contractor shall submit a copy of the contractor's certification along with those of all listed subcontractors. All non-listed subcontractors and lower tier subcontractors shall be registered prior to starting work on the project. It is the general contractor's responsibility that all non-listed subcontractors at any tier have their certificate prior to starting work on the job.

Under the law a "contractor" is "a person, partnership, association, joint stock company, trust, corporation or other legal business entity or successor thereof who enters into a contract" which is subject to the provisions of the New Jersey Prevailing Wage Act (N.J.S.A. 34:11-56.25, et seq.) It applies to contractors based in New Jersey or any other state.

To register, a contractor must provide the State Department of Labor with a full and accurately completed application form. The form is available online at www.state.nj.us/labor/lsse/lspubcon.html. N.J.S.A. 34:11-56.55 specifically prohibits accepting applications for registration as a substitute for a certificate of registration.

New Jersey Anti-Discrimination

Pursuant to N.J.S.A. 10:2-1, if awarded a contract, the contractor agrees that:

a. In the hiring of persons for the performance of work under this contract or any subcontract hereunder, or for the procurement, manufacture, assembling or furnishing of any such material, equipment, supplies or services to be acquired under this contract, no contractor, nor any person acting on behalf of such contractor or subcontractor , shall, by reason of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex, discriminate against any person who is qualified and available to perform the work to which the employment relates;

b. No contractor, subcontractor, nor any person on his behalf, shall in any manner, discriminate against or intimidate any employee engaged in the performance of work under this contract or any subcontract hereunder, or engage in the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under such contract, on account or race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex;

c. There may be deducted from the amount payable to the contractor by the contracting public agency, under this contract, a penalty of $50.00 for each person for each calendar day which such a person is discriminated against or intimidated in violation of the provisions of the contract; and

d. This contract may be canceled or terminated by the contracting public agency, and all money due to become due hereunder may be forfeited, for any violation of this section of the contract occurring after notice to the contractor from the public agency of any prior violation of this section of the contract.

American with Disabilities Act 1990

The contractor and the owner do hereby agree that the provisions of Title 11 of the Americans with Disabilities Act of 1990 (the "Act") *(42 U.S.C. S121 01 et seq.),* which prohibits discrimination on the basis of disability by public entities in all services, programs, and activities provided or made available by public entities, and the rules and regulations promulgated pursuant there unto, are made part of this contract. In providing any aid, benefit, or service on behalf of the owner pursuant to this contract, the contractor agrees that the performance shall be in strict compliance with the act. In the event that the contractor, its agents, servants, employees, subcontractors violate or are alleged to have violated the act during the performance of this contract, the contactor shall defend the owner in any action or administrative proceeding commenced pursuant to the act. The contractor shall indemnify, protect, and save harmless the owner, it agents, servants, and employees from and against any and all suits, claims, losses, demands, or damages, of whatever kind of nature arising out of or claimed to arise out of the alleged violation. The contractor shall, at its own expense, appear, defend, and pay any and all charges for legal services and any and all costs and other expenses arising from such action or administrative proceeding or in connection therewith. In any and all complaints brought pursuant to the owner's grievance procedure, the contractor agrees to abide by any decision of the owner which is rendered pursuant to said grievance procedure. If any action or administrative proceeding results in an award of damages against the owner, or if the owners incurs any expense to cure a violation of the ADA which has been brought pursuant to its grievance procedure, the contractor shall satisfy and discharge the same at its own expense.

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The owner shall, as soon as practicable after a claim has been made against it, give written notice thereof to the contractor along with full and complete particulars of the claim, if any action or administrative proceeding is brought against the owner or any of its agents, servants, employees, the owner shall expeditiously forward to the contractor every demand, complaint, notice, summons, pleading, or other process received by the owner or its representatives.

It is expressly agreed and understood that any approval by the owner of the services provided by the contactor pursuant to this contract will not relieve the contractor of the obligation to comply with the Act and to defend, indemnify, protect, and save harmless to the pursuant to this paragraph.

It is further agreed and understood that the owner assumes no obligation to indemnify or save harmless the contractor, its agents, servants, employees and subcontractors for any claim which may arise out of their performance of this Agreement. Furthermore, the contractor expressly understands and agrees that the provisions of this indemnification clause shall in no way limit the contractor's obligations assumed in this Agreement, nor shall they be construed to relieve the contractor from any liability, nor preclude the owner from taking any actions available to it under any other provisions of the Agreement or otherwise at Law.

Disclosure of Investment Activities in Iran:

Pursuant to Public Law 2012, c. 25, any person or entity that submits a bid or proposal or otherwise proposes to enter into or renew a contract must complete the certification below to attest, under penalty of perjury, that neither the person or entity, nor any of its parents, subsidiaries, or affiliates, is identified on the Department of Treasury's Chapter 25 list as a person or entity engaging in investment activities in Iran. The Chapter 25 list is found on the Division's website at:

http://www.state.nj.us/treasury/purchase/pdf/Chapter25List.pdf.

Bidders must review this list prior to completing the below certification. Failure to complete the certification will render a bidder's proposal non-responsive. If the Director finds a person or entity to be in violation of law, s/he shall take action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the party.

Certification of Non-Involvement in Prohibited Activities in Russia or Belarus.

Pursuant to Public Law 2022,c.3, any person or entity that submits a bid or proposal or otherwise proposes to enter into or renew a contract must complete the certification below to attest, under penalty of perjury, that neither the person or entity, nor any of its parents, subsidiaries, or affiliates, is identified as a person or entity engaging in prohibited activities

in Russia or Belarus as such terms is defined in P.L. 2202.c.3, section1.e, except as permitted by federal law.

Diane B. Allen Equal Pay Act

Pursuant to N.J.S.A. 34:11-56.14, a contractor performing "qualifying services" or "public work" to the State or any agency or instrumentality of the State shall provide the Commissioner of Labor and Workforce Development a report regarding the compensation and hours worked by employees categorized by gender, race, ethnicity, and job category. For more information and report templates see https://nj.gov/labor/equalpay/equalpay.html.

Disabled Veteran-Owned Business Set-Aside

In accordance with the New Jersey Set-Aside Act for Disabled Veterans' Businesses, N.J.S.A. 52:32-31.1 et seq. (P.L. 2015, c. 116), it is the policy of the Commission that Disabled Veteran-Owned Businesses ("**DVOBs**"), as determined and defined by the State of New Jersey, Department of Treasury, Division of Revenue and Enterprise Services in N.J.A.C. 17:14-1.1 et seq. (the "**Division**"), have the opportunity to compete for and participate in the performance of contracts and subcontracts for construction services. The Commission further requires that its Contractors shall agree to take all necessary and responsible steps, in accordance with the aforementioned regulations, to ensure that DVOBs have these opportunities. The Contractor is encouraged to obtain a complete copy of the applicable regulations (N.J.A.C. 17:14-1.1 et seq.) prior to submitting bids to the Commission.

The Contractor agrees to make a good faith effort to award at least 3% of this Contract to Subcontractors registered by the Division as a DVOB firm. Subcontracting goals do not apply if the prime Contractor is a registered DVOB firm.

The following actions shall be taken by a bidder in establishing a good faith effort to solicit and award subcontracts to eligible disabled veteran-owned businesses, as established in the RFP:

1) The bidder shall attempt to locate qualified potential disabled veteran-owned business subcontractors;

2) The bidder shall consult the disabled veteran business database if none are known to the bidder;

3) The bidder shall keep a record of its efforts, including the names of businesses contacted and the means and results of such contacts, as well as documentation

on any good faith efforts to solicit and award any subcontract to an eligible disabled veteran-owned business; and

4) The bidder shall provide all potential subcontractors with detailed information regarding the specifications.

In those circumstances where Federal law, rules, or regulations permit or require a procurement procedure other than those prescribed in this chapter, the State contracting agency shall follow the Federal procedures notwithstanding the provisions of this chapter, provided that the State contracting agency issues a written declaration that such Federal laws, rules, or regulations are in effect.

The Commission requires that DVOB Forms A, B, C, D, and F as applicable, be submitted within seven (7) days after Notice of Award. However, the Commission may extend the deadline for this requirement at its sole discretion.

If the Contractor submits the DVOB forms within the requested timeframe, but fails to meet the DVOB goal, a fully completed and notarized DVOB Form D must be submitted, and the Commission will evaluate the efforts made by the Contractor to determine whether a demonstration of good faith efforts has been made.

The listing of a DVOB firm by a Contractor on Form A shall constitute a representation by the Contractor to the Commission that such DVOB firm is qualified and available, and a commitment by the Contractor that it will enter into a subcontract with such DVOB firm for the portion of the work described in Form A and at the price set forth in its Bid. A DVOB Contractor which lists itself on Form A is committed to performing the work indicated with its own personnel.

A database of DVOBs is maintained by the State, accessible via a link on the Division's webpage at https://www20.state.nj.us/TYTR_SAVI/vendorSearch.jsp; the database lists vendors by designation, including DVOBs, and is available for use by State contracting agencies and others in confirming eligibility for set-aside contracts and subcontracts and in reporting progress toward established contract award goals. Use of this listing does not relieve the Contractor of its responsibility to seek DVOB participation from other sources.

Whenever the Commission issues Project Change Orders, the Commission may determine if increased DVOB participation will be required.

If at any time the Contractor believes or has reason to believe that a proposed DVOB has become unavailable or, due to change in ownership or management

responsibility, does not meet the applicable standards, the Contractor shall, within 10 days, notify the Commission of that fact. Within 15 days thereafter, the Contractor shall, if necessary to achieve the stated goal, make every reasonable effort to subcontract the same or other work to other DVOB firms.

Should a DVOB become ineligible during the course of this Contract, effective as of the date of ineligibility, further contractual dollars expended with the DVOB shall not be counted toward the DVOB goal. Within 15 days after notification by the Commission to the Contractor of the ineligible DVOB, the Contractor will make every reasonable effort to satisfy the DVOB goal. The Contractor's effort to continue to meet the DVOB goal shall be coordinated with the Office of EEO.

To ensure that all obligations under subcontracts awarded to DVOBs are met, the Commission shall review the prime Contractor's DVOB involvement efforts during the performance of the contract. The Contractor shall monitor the performance of and collect and report data on DVOB participation to the **Office of EEO**. The form will be reviewed to determine Contract compliance with respect to the DVOB goal. Failure to submit this report may result in suspension of payments as provided in the section titled "Audit and Penalties" below. If, at any time, the Commission has reason to believe that any person or firm has willfully and knowingly provided incorrect information or made false statements, it shall refer the matter to the Attorney General of the State of New Jersey.

The Contractor agrees to pay each subcontractor and supplier for satisfactory performance of its subcontract no later than ten (10) days from the receipt of each payment the Contractor receives from the Commission.

In accordance with N.J.S.A. 52:32-40 and 52:32-41, the Contractor shall certify, prior to the issuance of a progress payment by the Commission, that all subcontractors and suppliers have been paid any amounts due from previous progress payments and shall be paid any amounts from the current progress payment. Alternatively, the Contractor shall certify that there exists a valid basis under the terms of the subcontract to withhold payment from the subcontractor or supplier and therefore payment is withheld.

If the Contractor withholds payment from the Subcontractor or supplier, the Contractor shall provide to the Subcontractor or supplier written notice thereof. The notice shall detail the reason for withholding payment and state the amount of payment withheld. The Contractor shall send a copy of the notice to the Surety of the Contract Bond. A copy of the notice shall also be submitted to the Commission with the certification that payments are being withheld.

Except as provided herein, the Contractor shall not have the work performed, or the materials or supplies furnished, by any other DVOB firm other than those named in

Form A. However, the Contractor may, in unusual situations, be permitted to substitute a subcontractor(s). A request for substitution must be in writing, with complete justification for the request. The Contractor must have approval of the Commission before substitution of the DVOB subcontractor, regardless of the reason for the substitution. Failure to obtain approval from the Commission could result in the prime Contractor being found to be in "noncompliance" with the requirements of the contract. The term "unusual situations" includes, but is not limited to, a DVOB subcontractor or DVOB joint venture partner(s):

1) Failure to qualify as a DVOB or maintain DVOB registration status.
2) Death or physical disability, if the named subcontractor or DVOB partner of the joint venture is an individual.
3) Dissolution, if a corporation or partnership.
4) Bankruptcy of the subcontractor, subject to applicable bankruptcy laws, and only in instances where the bankruptcy affects the subcontractor's ability to perform.
5) Inability to obtain, or loss of, a license necessary for the performance of the particular category of work.
6) Failure or inability to comply with a requirement of law applicable to the subcontract work.
7) Material failure to comply with the terms and conditions of the subcontract.
8) Material failure to successfully perform the subcontract tasks.

The prime Contractor is advised that failure to carry out the requirements of these specifications shall constitute a breach of contract and may result in termination of the contract by the Commission, or such remedy as the Commission deems appropriate. During the performance of the contract, and for a period of up to three (3) years following completion of the contract work, the Commission may conduct reviews for compliance with the requirements of the DVOB Program. Such reviews may include the evaluation of monthly reports, desk audits, and site visitations. Where a Prime Contractor, or any Subcontractor, is found to be in noncompliance with the requirements of the DVOB Program during the performance of the contract, it will be required to take corrective action. If corrective action is not promptly taken by the offending contractor, the following sanctions may be instituted (singularly, in any combination and in addition to any other remedies provided by law):

1) The Commission may withhold further payments under the Contract.
2) The Contract may be terminated for breach.
3) Suspension or debarment proceedings may be commenced in accordance with New Jersey law and the Commission regulations.
4) The Contract Bond may be enforced.

Copies of the following forms are located on the Commission website*:*

(a) Commission Form A: DVOB Participation Schedule:
List all DVOB firms scheduled to participate in the contract, including scope of work to be performed and the dollar value of their anticipated

participation. Additionally, the name of the Contractor's DVOB liaison officer should be included on this form. Upon execution of a contract with the Commission the prime contractor must enter into a formal agreement with the DVOB(s) listed on Form A. There can be no substitution of the DVOB(s) listed on Form A without the prior written approval of the Commission. If, for any reason Form A is not completed, then the Contractor must complete and provide Form D (see below).

(b) Commission Form B: Affidavit of DVOB (If Applicable):
For each DVOB owned firm listed on Form A, Contractor shall include a complete and signed Form B. This form B is not required for set aside contract awards, nor in cases wherein the Contractor is a DVOB itself.

(c) Commission Form C: Affidavit of DVOB (If Applicable):
Each DVOB firm to be utilized must sign Form C attesting to its status as a DVOB.

(d) Commission Form D: DVOB Unavailability Certification (If Applicable):
If the Contractor is unable to identify DVOB(s) as required to meet the targeted goal set for this Contract, the Contractor shall complete and attach this form which documents the Contractor's good faith efforts to do so.

(e) Commission Form E: DVOB Certificate of Participation:
This is the payment report that must be completed on a monthly basis by the Contractor, unless the Contractor is a DVOB itself.

(f) Commission Form F: DVOB Certificate of Participation if Prime Contractor
is DVOB): If the Contractor is a DVOB itself, the Contractor shall complete this form and attach it with every Pay Estimate.

Prompt Payment of Construction Contracts Act*:*

On September 1, 2006, the New Jersey Legislature passed the Prompt Payment of Construction Contracts Act, N.J.S.A. 2A:30A-1 et seq.

N.J.S.A. 2A:30A-1 et seq. provides, in part, as follows: "If a prime contractor has performed in accordance with the provisions of a contract with the owner and the billing for the work has been approved and certified by the owner or the owner's authorized approving agent, the owner shall pay the amount due to the prime contractor for each periodic payment, final payment or retainage monies not more than thirty (30) calendar days after the billing date, which for a periodic billing, shall be the periodic billing date specified in the contract. The billing shall be deemed approved and certified twenty (20) days after the owner receives it unless the owner provides, before the end of the 20-day period, a written statement of the amount withheld and the reason for withholding

payment, except that in the case of a public or governmental entity that requires the entity's governing body to vote on authorizations for each periodic payment, final payment or retainage monies, the amount due may be approved and certified at the next scheduled public meeting of the entity's governing body, and paid during the entity's subsequent payment cycle, provided this exception has been defined in the bid specifications and contract documents."

As a public entity that requires the authorization of its governing body for periodic or final payments, and payments for change orders or release of retainage, the Commission hereby places the prime contractor on notice that it not subject to the twenty (20) day period for the approval and certification of billings and, consistent with N.J.S.A. 2A:30A-1 et seq., in the event that the Commission is unable to obtain formal consideration and approval of any billing for work performed by a prime contractor as the basis for a periodic or final payment, or payments for change orders or retainage within the thirty (30) day time period mandated by N.J.S.A. 2A:30A-1 et seq., the Commission shall place the billing for work performed on its next regularly scheduled meeting of its Board of Commissioners and, should such billing for work performed be approved, pay the approved amount to the prime contractor during the Commission's subsequent payment cycle.

New Jersey Prevailing Wage Act (N.J.S.A 34.11-56.25 et seq.): Contractors on projects for public work shall adhere to all requirements of the New Jersey Prevailing Wage Act. The contractor shall be required to submit a certified payroll record to the Commission within (10) days of the payment of wages. In the event that is found that any worker, employed by the contractor or any subcontractor has been paid a rate of wages less than the prevailing wage required to be paid, the Commission may terminate the contractor's or subcontractor's right to proceed with work, or such part of work as to which there has been a failure to pay required wages and prosecute the work to completion.

The contractor is also responsible for obtaining and submitting all subcontractors' certified payroll records within the aforementioned time period. The contractor shall submit said certified payrolls in the form set forth in N.J.A.C 12:60-6.1(c). It is the contractor's responsibility to obtain any additional copies of the certified payroll for to be submitted by contacting the New Jersey Department of Labor and Workforce Development, Division of Workplace Standards. Additional information is available at http:lwd.dol.state.nj.us/labor/wagehour/wagerate/pwr_construction.html.

The Contractor is put on notice that it must pay all of its employees rendering service under this Contract in compliance with the prevailing wage rates promulgated by the New Jersey Department of Labor, a copy of which is on file at the Commission's Administrative Offices in Wanaque, New Jersey, and is hereby made a part of this Contract. In addition, the Contractor shall conform to all other labor laws and statutes established in this State.

Bid

All bidders are considered to have full knowledge of the conditions and requirements, including the physical characteristics of the site and the project, which are necessary for an accurate bid. The Commission assumes no responsibility with respect to ascertaining

for the Bidder the facts of these physical characteristics, other than the facilitation of the Pre-Bid Meeting and site tour. The Bidder shall be held to be aware of the Commission's requirements prior to the time of submitting bids and to have appraised all conditions under which the Contract is to be performed.

TO: THE NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION

FOR: CONTRACT #2112 WSPS HVAC REPLACEMENT PROJECT

MADE THIS_____DAY OF_____ 2023

BY: _____

ADDRESS: _____

Bidder's Declaration: The party above named, as bidder, declares that the only person or persons interested in this bid as principal or principals is or are named above, and that no other person than hereinabove named has any interest in this Bid or in the Contract proposed to be taken; that this Bid is made without any connection with any other person or persons making a Bid for the same purposes; that the bid is in all respects fair and without collusion or fraud and that no officer or employee of the Commission is, shall be, or become, directly or indirectly, interested as contracting party, partner, stockholder, surety, or otherwise in the performance of the Contract, or in the supplies, work or business to which it relates or in any portion of the profits thereof; that he has had an opportunity to examine the site of the work; that he has examined the form of Contract, Technical Specifications, therein referred to, and has read the Information for Bidders hereto attached; and he proposes and agrees, if this Bid be accepted, that he will contract in the form provided, to perform all the work and furnish all material(s) mentioned in said form of Contract and Technical Specifications, and that he will accept in full payment therefore the following sum, to wit:

FOR THE WSPS HVAC REPLACEMENT PROJECT for the North Jersey District Water Supply Commission, including labor, equipment, materials and warranty and all work described in the Scope of Work, Technical Specifications, Exhibit “A”, and Exhibit “B”, for the lump sum price of _____

dollars and _____ cents ($_____) (“Base Bid”)

OPTION PRICING FOR CLEANING THE HEATING & COOLING DUCTWORK FOR THE OFFICE AREA ONLY NOTED ON DRAWING M101 KEY NOTE #3 including labor, equipment, materials and warranty and all work described in the Scope of Work, Technical Specifications, Exhibit “A”, and Exhibit “B”, for the lump sum price of _____

dollars and _____ cents ($_____)
("Option")_

OPTION PRICING

Option pricing shall be provided by the bidder. The Commission has the right to select the Option, or forgo the Option. Contract award shall be made to the lowest, responsible bidder based on the total for the Base Bid plus the Option, if selected by the Commission at the time of award

NOTE: The price shall be printed in ink both words and figures. Any bid which fails to name a price both in words and in figures for the Base Bid and the Option, per unit and every item, wherein quantities are given, may be held to be non-responsive and may be rejected. In case of any discrepancy or conflict, the price written in words will take precedence over the written in figures and unit prices will take precedence over the sum of individual items.

What the Price is to Cover: The price is to include and cover the furnishing of the machinery, tools, apparatus and other means of construction and all material and labor necessary to complete the work in the manner and within the time set forth in the Contract.

Time within which Contract is to be Executed: The Successful Bidder shall execute this Contract and give to the Commission the required security within seven (7) working days from the date that said Contract has been awarded to him. Upon failure to do so, said Bidder will be considered as having abandoned the Contract.

Bidder acknowledges that the Commission reserves the right to reject any or all Bids which may be non-responsive or the acceptance of which, in the sole judgment of the Commission, may be detrimental to its interests.

Respectfully submitted,

_____

BIDDER

_____ _____

SIGNATURE OF AUTHORIZED AGENT TYPE OR PRINT NAME

_____

TITLE

_____ _____

TELEPHONE NUMBER E-MAIL ADDRESS

_____

WITNESS (IF INDIVIDUAL, PARTNERSHIP OR OTHER BUSINESS ENTITY)

_____

ATTEST: (CORPORATION) SECRETARY

NOTE: AFFIX CORPORATE SEAL

CONTRACT #2112

EXPERIENCE STATEMENT

TO: NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION

Commissioners:

We hereby certify that we have performed the work listed below to the satisfaction of the Governing Bodies or Public Entities listed below. We further certify that we have never defaulted under any contract with a Municipality, County, or State, or any other Public Entity.

Note: Include no less than Five (5) references. (Experience Statement may be attached)

Give name of Public Entity or Unit of Government, nature of work, amount of work performed, when completed, and name and telephone number of party in charge of work.

_____

_____

_____

_____

_____

_____

WITNESS

_____

NAME OF COMPANY

_____

ADDRESS

_____

DATE

BY: _____

SIGNATURE

_____

PRINT NAME AND TITLE

CONTRACT #2112

EQUIPMENT STATEMENT

TO: NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION

Commissioners:

We hereby certify that we are fully prepared with the necessary capital, material, and machinery to conduct the work as herein specified, and we further certify that the equipment required for the proper execution of this contract in the time specified is available as follows:

_____

_____

_____

_____

_____

_____

BY: _____
SIGNATURE

_____
PRINT NAME AND TITLE

_____ _____
WITNESS COMPANY NAME

_____ _____
DATE ADDRESS

LISTING OF SUBCONTRACTORS TO BE USED

Each Bidder shall submit to the Commission with its Bid, the List of Subcontractors proposed to be employed by the Contractor, complete with the names of all such Subcontractors, Suppliers, and other individuals and entities and the percentage of work to be performed by each Subcontractor. The list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity, for each Subcontractor's work that is proposed to exceed ten (10) percent of the Bid price. If, after due investigation, the Commission has reasonable objection to any proposed Subcontractor, Supplier, or other individual or entity, the Commission may, before the Notice of Award is given, request the apparent Successful Bidder to submit an acceptable substitute Subcontractor without an increase in the Bid Price.

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

Should a Contractor utilize a substitute Subcontractor, Contractor shall immediately submit a revised form to the Commission, with the requisite information and documentation relating to the substitute Subcontractor.

WORK CATEGORY	SUBCONTRACTOR NAME	SUBCONTRACTOR ADDRESS

(Attach additional pages as required)

NOTE: Submission of the names and addresses of the Subcontractors is essential and non-waivable. Also, proof of registration pursuant to Public Works Contractors Registration Act for all named subcontractors is required to be provided prior to the award of a contract. Where ***more than one*** Subcontractor is named for a trade category, the bidder must identify, in the Bid, the scope of work that is to be performed by each subcontractor. Failure to comply with these requirements will result in the Bid being deemed nonresponsive.

CONTRACT #2112

NONCOLLUSION AFFIDAVIT

STATE OF **}**
S.S.:
COUNTY OF **}**

I _____ of the city of_____in the County of _____ and the State of _____ of full age, being duly sworn according to the law on my oath depose and say that: I am of the firm of _____
(Title)
the Bidder making the Bid for the above named project, and that I executed the said Bid with authority so to do; that said Bidder has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive bidding in connection with the above-named project; and that all statements contained in the said Bid and in this Affidavit are sure and correct, and made with full knowledge that the **NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION** relies upon the truth of the statements contained in said Bid and in the statements contained in this Affidavit in awarding the Contract for the said project.

I further warrant that no person or selling agency has been employed or retained to solicit or secure such Contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, except bona fide employees or bona fide established commercial or selling agencies.

_____ _____
NAME OF CONTRACTOR OFFICER'S SIGNATURE

(Original signature only, stamped signature not accepted)

Subscribed and sworn
to before me this___day
of _____ 2023.

Notary Public of the State of_____.

My Commission expires _____, _____.

Affix notary stamp or print name below signature.

_____
NOTARY'S SIGNATURE

CONTRACT #2112

BIDDER DISCLOSURE STATEMENT

NOTE: **IF YOU FAIL TO PROPERLY OR CLEARLY COMPLETE THIS BIDDER DISCLOSURE STATEMENT, OR IF YOU FAIL TO INCLUDE IT WITH YOUR BID, YOUR BID WILL BE REJECTED.**

N.J.S.A. 52:25-24.2, requires that all corporate and partnership bidders for public contracts submit a list of names and addresses of all stockholders owning 10% or more of any class of their stock or 10% or more of the stock of a corporate bidder; or, in the case of partnership, the names and addresses of those partners owning 10% or greater interest in the partnership. Furthermore, the Commission requires a statement from all bidders which, regardless of business form, must likewise indicate all principals of the bidder.

Therefore, this Bidder Disclosure Statement must be fully and accurately completed. If no entity or person owns 10% or more of any class of stock of your corporation, or of an interest in your partnership or other business entity, write the word **"NONE"** below and execute this document as indicated.

I. **BUSINESS FORM**:

INDICATE THE BUSINESS FORM BY PLACING AN "X" IN THE APPROPRIATE SPACE:

{ } CORPORATION
{ } PARTNERSHIP
{ } OTHER, SPECIFY _____

II. **PRINCIPALS**:

NAME	HOME ADDRESS	TITLE	% OF OWNERSHIP
1._____			
2._____			
3._____			
4._____			

If one or more of the owners of the bidder is itself a corporation, partnership or other business entity, then for that owner, you must set forth the name, home address, title and percentage of ownership of every person who is an owner of 10% or more of that corporation, partnership or other business entity.

CONTRACT #2112

BIDDER DISCLOSURE STATEMENT

NAME	HOME ADDRESS	TITLE	% OF OWNERSHIP
1.			
2.			
3.			
4.			

ATTEST (FOR CORPORATION)

BY: _____

NAME: _____

TITLE: _____

WITNESS (FOR PARTNERSHIP OR OTHER BUSINESS ENTITY)

BY: _____ _____

NAME: _____

TITLE:_____

BY: _____ _____

NAME: _____

TITLE: _____

NOTE: If the bidder is a corporation, the corporation's corporate seal must be affixed.

BID #2112

CONSENT OF SURETY

KNOW ALL MEN BY THESE PRESENTS, THAT _____, a corporation of the State of _____having its principal office at _____being (a) surety company(ies) qualified to do business in the State of New Jersey, in consideration of the premises, and of one dollar to it (them) in hand paid by the Commission, and of other good and valuable consideration the receipt whereof is hereby acknowledged, do(es) consent and agree, that if the Contract for which the preceding bid is made be awarded to the person or persons making the same; it (they) will, upon award of such Contract, become surety, first, for the full and faithful performance of said work, and, secondly, for the protection of all persons in the performance of said Contract in the form required by N.J.S.A. 2A:44-143 to 2A:44-147 and the amendments thereof and supplements thereto; the performance bond and the labor, material and supply obligations each to be conditioned so as to indemnify the Commission against loss due to the failure of the Contractor to meet the stipulations of the respective bonds; said bond to be in the amount of 100% of the Contract price.

IN WITNESS WHEREOF, the said _____ has (have) caused its (their) corporate seal(s) to be hereto affixed and these presents to be signed by its (their) _____ and attested to by its (their) _____this _____ day of Two Thousand and Twenty-Three.

_____
Corporate Seal

By: _____

_____ (as Surety)

ATTEST:

_____

THE CONSENT OF SURETY FORM ABOVE CONTAINS THE LANGUAGE THE COMMISSION FINDS ACCEPTABLE.

WE SUGGEST THE ABOVE BE COMPLETED BY YOUR SURETY COMPANY(IES) AND SUBMITTED WITH YOUR BID IN LIEU OF SUBMITTING THE SURETY'S OWN FORM.

BY DOING THIS, YOU REDUCE THE RISK OF YOUR BID BEING REJECTED FOR HAVING SUBMITTED A CONSENT OF SURETY WHICH CONTAINS INCORRECT AND UNSATISFACTORY LANGUAGE.

NOTE: THE INDIVIDUAL EXECUTING THE SURETY CONSENT ON BEHALF OF THE SURETY MUST SUPPLY WITH THE CONSENT, WRITTEN EVIDENCE THAT HE OR SHE IS AUTHORIZED TO BIND THE SURETY AS OF THE DATE OF THE EXECUTION OF THE CONSENT.

BID #2112

ACKNOWLEDGMENT OF RECEIPT OF CHANGES TO BID DOCUMENTS FORM

_____

(Name of Contracting Unit)

_____ _____

(Name of Construction/Public Works Project) **(Project or Bid Number)**

The undersigned Bidder hereby acknowledges receipt of the following notices, revisions, or addenda to the bid advertisement, specifications or bid documents. By indicating date of receipt, Bidder acknowledges the submitted Bid takes into account the provisions of the notice, revision or addendum. Note that the Commission's record of Notice to Bidders shall take precedence and that failure to include provisions of changes in a Bid may be subject for rejection of the Bid. In the event that no notices, revisions or addenda to the bid advertisement, specifications or bid documents are received by the Bidder, the Bidder must indicate ***"none"*** in the space below. ***Failure to submit "Acknowledgment of Receipt of Changes to Bid Documents Form" shall be deemed a material and non-waivable defect, and shall be cause for rejection of the Bid without further consideration.***

Commission's Reference Number or Title of Addendum/Clarification	How Received (mail, fax, pick-up, etc.)	Date Received

Acknowledgment by Bidder:

Name of Bidder: _____

By Authorized Representative: _____

Signature: _____

Printed Name and Title: _____

Date: _____

BID #2112

SAFETY TRAINING ACKNOWLEDGMENT

_____

(Name of Contracting Unit)

_____ _____

(Name of Construction/Public Works Project) **(Project or Bid Number)**

All equipment and work methods utilized in this Contract shall comply with OSHA and all other applicable local, state and/or federal safety standards and regulations. Contractor and all subcontractors shall be required to attend a Contractor Safety Orientation prior to beginning construction.

Acknowledgment by Bidder:

Name of Bidder: _____

By Authorized Representative: _____

Signature: _____

Printed Name and Title: _____

Date: _____

BID #2112

SECURITY MEASURES ACKNOWLEDGMENT

_____

(Name of Contracting Unit)

_____ _____

(Name of Construction/Public Works Project) **(Project or Bid Number)**

The undersigned Bidder hereby acknowledges that he/she is familiar with the Commission's security requirements for this project and agrees to abide by same. The Contractor shall be responsible for insuring that all subcontractors for this project abide by these security measures as well.

Contractors and all subcontractors shall be required to comply with said requirements prior to beginning construction on this Contract.*

Acknowledgment by Bidder:

Name of Bidder: _____

By Authorized Representative: _____

Signature: _____

Printed Name and Title: _____

Date: _____

***As required by the New Jersey Office of Counter Terrorism's Best Management Practices, Contractors must provide evidence that it has previously conducted a background check on all Contractor's employees who will be entering onto Commission property. Contractors shall provide the Commission with a corporate letter, on appropriate letterhead, stating the names of all employees who will require access to the Commission's property, and indicating that such background checks have, in fact, been performed. All subcontractors are also required to provide such employee list, and confirmation of background checks**

BID #2112

BID CHECKLIST

ALL ITEMS LISTED BELOW MUST ACCOMPANY THIS BID UNLESS OTHERWISE INDICATED. PLEASE CHECK ALL ITEMS BEFORE SUBMITTING:

A) FAILURE TO PROVIDE OR PROPERLY COMPLETE OR SIGN ANY OF THESE ITEMS BELOW WILL RESULT IN A MANDATORY REJECTION OF THE BID.

___ (1) SECURITY IN THE FORM OF:

___ A BID BOND IN AN AMOUNT EQUAL TO 10% OF THE TOTAL AMOUNT OF THIS BID, NOT TO EXCEED $20,000.

OR

___ A CERTIFIED CHECK IN THE AMOUNT OF 10% OF THIS BID, BUT NOT IN EXCESS OF $20,000.

OR

___ A CASHIER'S CHECK IN THE AMOUNT OF 10% OF THIS BID, BUT NOT IN EXCESS OF $20,000.

___ (2) SURETY COMPANY CONSENT (IN ADDITION TO SECURITY IN ITEM #1 ABOVE).

___ (3) BIDDER DISCLOSURE STATEMENT

___ (4) ACKNOWLEDGMENT OF RECEIPT OF CHANGES TO BID DOCUMENTS

B) FAILURE TO PROVIDE OR PROPERLY COMPLETE OR SIGN ANY OF THE ITEMS BELOW MAY RESULT IN A REJECTION OF THE BID.

___ (1) BUSINESS REGISTRATION CERTIFICATE FOR CONTRACTOR OR ANY SUBCONTRACTORS

___ (2) PROOF OF PUBLIC WORKS CONTRACTOR REGISTRATION OR ANY SUBCONTRATORS

___ (3) LIST OF SUBCONTRACTORS

___ (4) EXPERIENCE STATEMENT

___ (5) EQUIPMENT STATEMENT

___ (6) NONCOLLUSION AFFIDAVIT

___ (7) SAFETY TRAINING ACKNOWLEDGMENT

___ (8) SECURITY MEASURES ACKNOWLEDGMENT

___ (9) COMPLETED CONTRIBUTION CERTIFICATION AND DISCLOSURE(S) (ATTACHMENT #2)

__ (10) DISCLOSURE OF INVESTMENT ACTIVITIES IN IRAN

___ ***(11)*** *CERTIFICATION OF NON-INVOLVEMENT IN PROHIBITED ACTIVITIES IN RUSSIA OR BELARUS PURSUANT TO P.L.2033, c.3*

(CONTRACTOR)

BY: _____

SIGNATURE

_____

PRINT NAME AND TITLE

CONTRACT #2112

GENERAL CONDITIONS

NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION
WANAQUE, NEW JERSEY

THIS AGREEMENT, made and entered into on the date set forth herein by and between the **NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION**, party of the first part, hereinafter designated as the Commission, and _____party of the second part, hereinafter designated as the Contractor.

COVENANTS: WITNESSETH, that the parties to these presents each in consideration of the undertakings, promises and agreements on the part of the other herein contained, have undertaken, promised and agreed, and do hereby undertake, promise and agree, the party of the first part for itself, its successors and assigns, and the party of the second part for heirs, executors and administrators, or successors and assigns, as follows:

PRICE FOR WORK: The Commission will pay and the Contractor shall receive as full compensation for furnishing all the shop drawings, materials and labor and for performing and completing all the work which is necessary or proper to be furnished or performed in order to complete the entire work in this Contract described and specified in said technical specifications and plans, described and shown; and also for all losses or damages arising out of the nature of the work aforesaid, or from any unforeseen obstruction or difficulty encountered in the prosecution of the work; and for all expenses incurred by or in consequence of the suspension or discontinuance of the work as herein specified, the prices stipulated as follows.

FOR THE WSPS HVAC REPLACEMENT PROJECT for the North Jersey District Water Supply Commission, including labor, equipment, materials and warranty and all work described in the Bid Specifications, Scope of Work, Technical Specifications, Exhibit "A", and Exhibit "B", for the lump sum price of _____

dollars and _____ cents ($_____)

OPTION PRICING FOR CLEAN THE HEATING & COOLING DUCTWORK FOR THE OFFICE AREA ONLY NOTED ON DRAWING M101 KEY NOTE #3 including labor, equipment, materials and warranty and all work described in the Scope of Work, Technical Specifications, Exhibit "A", and Exhibit "B" , for the lump sum price of _____

dollars and _____ cents ($_____)

CONTRACT #2112

GENERAL CONDITIONS

NOTE: The price shall be printed in ink both words and figures. Any bid which fails to name a price both in words and in figures per unit and every item, wherein quantities are given, may be held to be non-responsive and may be rejected. In case of any discrepancy or conflict, the price written in words will take precedence over the written in figures.

WHAT THE PRICE IS TO COVER: The price is to include and cover the furnishing of the machinery, tools, apparatus and other means of construction and all material and labor necessary to complete the work in the manner and within the time set forth in the Contract.

Article I - DEFINITIONS:

Commission: the **NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION**, Wanaque, New Jersey; the party of the first part to this Contract.

Contractor: the party of the second part to this Contract.

Contract: this Agreement covering the performance of the work for the project and payments therefore, including the general conditions, the Bid Specifications for **Contract #2112** (including any Addendums/Clarifications), the Proposal and all sheets, forms or documents attached to the Bid Specifications or hereto.

Engineer: Commission's Engineering Staff.

Exhibits: Exhibit A, and Exhibit B included at the end of this Contract, incorporated herein by reference.

Proposal: the proposal submitted by the Contractor, dated _____, 2023, incorporated herein by reference.

Specifications: the Technical Specifications included As Exhibit A to this Contract, incorporated herein by reference.

Article II - RIGHTS AND DUTIES OF THE ENGINEER:

A. The Engineer shall, subject to the provision of Articles III and IV, give all orders and directions contemplated under this Contract and determine in all cases the amount, quality, acceptability and fitness of the work and materials which are to be paid for by the Commission to the Contractor.

B. The Engineer shall have the right to reject any or all work which does not conform to the plans and specifications of this Contract, or is not completed in a workmanlike manner. She/He shall also have the right to reject materials which do not meet the specifications herein contained, have become damaged, rendered unsatisfactory, or have been supplied without evidence of quantity and/or quality such as labels, bills of lading, etc.

C. The Engineer shall have the free access to the work whenever and wherever it is in progress, for purposes of inspection. If any work should be covered up without prior approval or consent of the Engineer, it must, if required by the Engineer, be uncovered for examination at the Contractor's expense.

D. The Engineer shall have the right to stop the work whenever such stoppage may be necessary for protection of the reservoir, for emergency conditions, or to prevent potential damage to property, equipment, or facilities and/or personal injury.

E. The Engineer shall provide the Contractor with such basic lines, grades and points as are needed from which the Contractor shall establish such other points as he may need, unless otherwise specified.

Article III - REVIEW BY COMMISSION:

Notwithstanding anything herein contained, the Contractor shall have the right to appeal to the Commission, in accordance with Article XXII, concerning any matter in dispute and the Commission's decision on such appeal shall be final.

Article IV - CHANGES:

A. Notwithstanding anything herein contained, no departure from or substitution, change or alteration in the terms, provisions or requirements of this Contract and the specifications thereof, shall be made without the prior order of the Commission as duly executed by its Chairman.

B. The Engineer, however, shall have the right to make minor changes in the specifications during the conduct of the work if necessary in keeping with good engineering practice if such changes are consistent with the purpose, intent and/or conditions of the contract and shall not result in significant extra costs to the Contractor.

C. Authorization for any additional work or materials (extras) requiring compensation not provided for in this Contract, or change orders, must be obtained in writing from the Commission. The Commission will not pay the Contractor for additional services or

materials based on verbal agreements or conversations with a Commission employee.

Article V - OBLIGATIONS OF THE CONTRACTOR:

A. The Contractor shall do all the work and furnish all the labor, supervision, transportation, materials, tools, equipment, etc., (except as herein otherwise provided)**,** in accordance with this Contract and the Technical Specifications and/or the direction of the Engineer. The Contractor shall complete said work to the total satisfaction of the Engineer at a price agreed upon and fixed by the terms of this Contract.

B. It is understood that the Contractor shall have had an opportunity to carefully examine the areas and/or facilities involved in this Contract prior to entering into this Contract and that he has fully satisfied himself as to the nature and location of the work, subsurface conditions, the character of equipment and facilities needed, the time and labor requirements, and all such matters which can affect the work to be performed. The Commission will not be responsible for additional expenses incurred by the Contractor as a result of obtaining information from any person or employee of the Commission in lieu of personal inspection or investigation.

C. The Contractor shall carefully preserve bench marks, reference points and stakes provided by the Engineer, and shall be responsible for any delays or mistakes that may be caused by their unnecessary loss or disturbance. The Contractor shall also carefully preserve all permanent property corners and bench marks, such as pipes, monuments, etc., and if lost or disturbed shall be responsible for resetting same, through the services of a licensed Land Surveyor whose services shall be paid for by the Contractor.

D. The Contractor shall continuously provide adequate protection at the work site to prevent the possibility of injury to any and all persons or property whether of the Commission or not. The Contractor shall secure the work site at any time when work is temporarily halted by reason of weather, time, etc., by providing adequate barricades, fences, lighting, personnel, etc., so as to prevent injury to persons or property. All such damage, injury or loss, except as may be due to errors in the Contract or caused by employees of the Commission, shall be made good by the Contractor.

E. The Contractor shall, during the progress of the work, attend the work site personally or through a competent English-speaking superintendent authorized to receive and carry out instructions.

F. The Contractor will be required to check all dimensions and quantities on any

drawings or specifications given to him by the Engineer. In case of error or omission, the Contractor will not be allowed to benefit thereby, and instead should report same to the Engineer to obtain special instructions.

G. The Contractor shall be responsible for all materials, tools, equipment, etc., to be stored at or near the job site.

H. The Contractor shall, upon completion of the work, and to the complete satisfaction of the Engineer, remove from all Commission and/or private property, at its own expense, all temporary structures, rubbish, spillage, waste materials, drums, etc., which have resulted from the Contractor's operations. Final inspection and/or acceptance of the project by the Engineer for payment will not be made until all work has been completed and all final cleaning operations have been performed.

Article VI - TIME FOR COMPLETING WORK, EXTENSION OF TIME, AND LIQUIDATED DAMAGES

A. **Time for Completing Work:**

The Contractor shall commence the work within seven (7) days from the issuance of the Notice to Proceed by the Commission. The Contractor shall achieve Substantial Completion within **Three Hundred-Sixty Five Days (365) Business Days of commencement of work.**

B. Working hours shall be between **7:30 a.m. to 5:00 p.m**. No work shall be permitted on Saturdays, Sundays and legal holidays without special prior consent of the Engineer.

C. Written approval of an extension of time, obtained by the Contractor from the Engineer, shall be the sole and exclusive remedy to the Contractor as a result of delays in the commencement, prosecution or completion of the work, resulting from, but not limited to:

1. acts or omissions of the Commission or Engineer or other contractor employed by the Commission, with respect to late drawings, plans or specifications, changes in sequence, lack of decision, lack of access, interference, errors, lack of approvals, erroneous bid specifications, lack of payments, issuance of change orders;
2. differing site conditions, strikes, labor or material shortages, unusual delays in transportation and acts of God, such as tornadoes, earthquakes or extreme weather.

D. The date of beginning and the time for completion, as specified herein, are **ESSENTIAL CONDITIONS** of this Contract; and it is agreed that the work embraced in this Contract shall be commenced within seven (7) days from the issuance of the

GENERAL CONDITIONS

Notice to Proceed. The work set forth in this Contract shall be prosecuted regularly, diligently and uninterruptedly at such rate of progress as shall insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the Commission, that the time for the completion of the work described herein is a reasonable time for the completion of the same taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.

E. LIQUIDATED DAMAGES

If the Contractor shall not complete the work within the same time herein specified, or any proper extension thereof granted by the Commission then the Contractor does hereby agree, as part consideration for the awarding of this contract, to pay the Commission ***Five Hundred Dollars ($500.00) per calendar day***, commencing on the 31st calendar day of non-completion, not as a penalty, but as a liquidated damages for such breach of contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the Bid Specifications and Contract for completing the work.

The Commission may, in its sole discretion, review any purported reasons for delay and consider an extension or change order pursuant to the terms of Contract. The Commission shall have the right to offset from monies owed the Contractor under this Contract any and all monies owed the Commission as Liquidated Damages

F. Time is of the essence for each and every portion of work required herein. Where additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence under this Contract.

G. The Contractor will not be charged with liquidated damages when, in the opinion of the Engineer, the delay in completion of the work is due to unforeseeable cause beyond the control and without the fault or negligence of the Contractor, such as but not restricted to, differing site conditions, strikes, labor or material shortages, unusual delays in transportation and acts of God, such as tornadoes, earthquakes or extreme weather.

Article VII - CONTRACTOR'S INSURANCE AND INDEMNIFICATION REQUIREMENTS

A. The Contractor shall, at all times during the term of this Agreement, obtain and maintain continuously, at its own expense, and file with the Commission and its insurance broker evidence of coverage as enumerated below.

1. Commercial General Liability Insurance:

Commercial General Liability Insurance, written on an industry standard occurrence form (CG 00 01), 1207 Edition or Equivalent

The Contractor shall maintain Products Completed Operations liability coverage for a period of at least 24 months following the Final Project Completion Date.

Such policy (ies) must provide the following minimum limits:

$2,000,000	General Aggregate - Applies Per Project
$1,000,000	Products & Completed Operations Aggregate
$1,000,000	Personal & Advertising Injury
$1,000,000	Each Occurrence Limit
$ 100,000	Fire Damage Legal Liability

Any deductible or self-insured retention must be disclosed and is subject to approval by the Commission. The Cost of any claim payments falling within the deductible shall be the responsibility of the Contractor.

2. Business Automobile Liability:

Including coverage for owned, non-owned, leased or hired vehicles, written on an industry standard form (CA 00 01) or equivalent. Such policy (ies) must provide the following minimum limits:

$1,000,000 Combined Single Limit (Bodily Injury & Property Damage)

Should include endorsement CA 9948 Pollution Endorsement

3. Worker's Compensation:

Worker's Compensation Limits: Statutory
Employer's Liability:

$1,000,000	Each Accident
$1,000,000	Disease – Policy Limit
$1,000,000	Disease – Each Employee

4. Excess/Umbrella Insurance:

Schedule of Underlying to include: General Liability, Employers Liability and Auto Liability as outlined above.

Minimum Limit of Liability: $3,000,000 Per Occurrence
$3,000,000 Aggregate

5. Evidence of Insurance:

The following documents must be provided in conjunction with a Certificate of Insurance:

- A copy of the endorsement naming the Commission as an Additional Insured, on Form CG2010 or equivalent on all policies except Worker's Compensation.

- A copy of an endorsement stating that the coverages provided by this policy to the Commission shall not be terminated, reduced or otherwise materially changed without providing at least thirty (30) days prior written notice to the Commission.

- A waiver of subrogation in favor of the Commission should apply under all the policies outlined in this section except for Worker's Compensation.

- General Contractor and Subcontractors "if any" are required to maintain the same level of coverage as outlined in section 1 and provide Certificates of Insurance and copies of supporting endorsements.

All policies must be rated A-VII or higher in the A.M. Best's Key Rating Guide and licensed to do business in the State of New Jersey or are an eligible Surplus Lines Insurer or are an acceptable Joint Insurance Fund.

Acceptance by the Commission of deficit evidence of insurance does not constitute a waiver of contract requirement as provided by conditions of the contract.

B. Indemnification

The Contractor hereby agrees to fully indemnify, defend and hold harmless the Commission, the Commissioners, its members, directors, officers, agents, servants, employees and successors and assigns from and against all losses, fines, penalties, damages, lawsuits, claims, causes of action, liabilities, demands, obligations to Contractor, and expenses, including attorneys' fees in connection with the loss of life, personal injury, bodily injury, and/or property damage, if occasioned in whole or in part by any negligent act or omission of the Contractor or the Contractor's agent's, servants, employees, and subcontractors in the performance of services and provision of goods under this Contract. This obligation shall include the provision of a defense for the Commission at all stages of the claims or judicial process and together with all losses, fines, penalties, costs and expenses relating to any of the foregoing, including but not limited to, court costs and reasonable attorneys' fees arising out of this Contract and to enforce this indemnification provision.

Article VIII - LAWS, REGULATIONS AND PERMITS:

A. The Contractor shall keep itself fully informed of all laws, ordinances and regulations

or decrees which in any manner would affect persons or materials in any way used, engaged or employed in the work or which affect the conduct of the work.

If any discrepancy or inconsistency should be discovered in this Contract, or in the drawings or specifications herein referred to, in relation to any such law, ordinance, regulation, order of decree, the Contractor shall forthwith report the same in writing to the Commission.

B. The Contractor shall at all times observe and comply with and shall cause all its agents and employees to observe all such laws, ordinances, regulations, orders and decrees, and shall protect, indemnify and save harmless the Commission and its officers and agents against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order or decree, whether by the Contractor, its employees or agents.

C. Permits and/or licenses of a temporary nature which are necessary for the prosecution of the work shall be secured and paid for by the Contractor prior to commencement of such work as would require permits and/or licenses.

Article IX - ASSIGNMENT:

A. The Contractor shall not assign, transfer, convey, sublet or otherwise dispose of this Contract, as a whole; or his right, title or interest in or to the same or any part thereof, without the previous consent in writing of the Commission endorsed herein or hereto attached; and it shall not assign, by power of attorney or otherwise, any of the monies to become due and payable under this Contract, unless by and with the like consent signified in like manner.

B. If the Contractor shall, without such previous written consent, assign, transfer, convey, sublet, or otherwise dispose of this Contract, or of its right, title or interest therein, or any of the monies to become due hereunder, this Contract may, at the option of the Commission, be revoked and annulled, and the Commission shall thereupon be relieved and discharged from any and all liability and obligations growing out of the same to the Contractor and to its assignee or transferee; and the Commission shall be in nowise deprived of or restricted in its right to sue for and recover damages for any breach of this Contract.

Article X - PATENTS:

The Contractor shall hold itself responsible for claims made against the Commission for infringement of patents by the use of patented articles in the construction and completion of the work, or in any process connected with the work agreed to be performed under this Contract or with the materials used upon the said work, and shall indemnify and save harmless the Commission for all costs, expenses and damages which the Commission shall be obliged to pay by reason of any infringement of patents used in the construction and completion of the work under this Contract, including attorney's fees.

Article XI - NEW JERSEY PREVAILING WAGE ACT (N.J.S.A 34.11-56.25 et seq.):

A. The Contractor is put on notice that it must pay all of its employees rendering services under this Contract in compliance with the prevailing wage rates promulgated by the New Jersey Department of Labor, a copy of which is on file at the Commission's Administrative Offices in Wanaque, New Jersey, and is hereby made a part of this Contract. In addition, the Contractor shall conform to all other labor laws and statutes established in this State.

B. In the event it is found that any employee of the Contractor or Subcontractor covered by this Contract has been paid a rate of wages less than the prevailing wages required to be paid by the Contractor or Subcontractor, this Commission shall have the right to terminate the Contract, or such part of the Contract as to which there has been a failure to pay the required wages and to prosecute the Contract to completion or otherwise. The Contractor and its sureties shall be liable to the Commission for any excess costs occasioned thereby.

Article XII - PAYMENTS:

The Contractor will be entitled to payment upon final inspection and acceptance of the work by the Commission's Engineer, less any retainage held by the Commission, within sixty (60) days after (a) all portions of work have been fully completed as required by the Contract to the satisfaction of the Engineer; and (b) the Engineer has certified such completion to the Commission.

The Contractor agrees that he shall indemnify and save the Commission harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen and furnishes of machinery and parts thereof, equipment power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this Contract. The Contractor shall, at the Commission's request, furnish satisfactory evidence that all obligations of the nature hereinabove designed have to be paid, discharged, or waived. If the Contractor fails to do so, then the Commission may, after having served written notice on the said Contractor, either pay unpaid bills, of which the Commission has written notice, directly or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor will be resumed, in accordance with the terms of this Contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Commission to the Contractor.

In paying any unpaid bills of the Contractor, the Commission shall be deemed the agent of the Contractor, and any payment, so made by the Commission, shall be considered as a payment made under the Contract by the Commission to the Contractor, and the

Commission shall not be liable to the Contractor for such payment made in good faith.

A. **Payment**:

1. Upon receipt of written notice from the Contractor that the project is complete, the Engineer will make a final inspection and will notify the Contractor in writing of any particulars in which this inspection reveals that the work is defective. The Contractor shall immediately make such corrections as are necessary to remedy such defects.

2. When the Contractor has completed all such corrections to the satisfaction of the Engineer and delivered all maintenance and operating instructions, schedules, as-built drawings, guarantees, bonds, certificates and other documents, all as required by the Contract, the Proposal and the Bid Specifications (the "Contract Documents"), he may make application for final payment. The Engineer will review actual as-built field measurements, the amount of the work by the Contractor, and the value of such work pursuant to the terms of the Contract to determine whether to issue a final acceptance of the work. Upon final acceptance of the work, the Engineer will process the final payment upon receipt of a Maintenance Bond as described in the Bid Specifications.

3. The acceptance by the Contractor of Final Payment shall be and shall operate as a release to the Commission of all claims and all liability to the Contractor for all things done or furnished in connection with this work and for every act or neglect of the Commission and others relating to or arising out of this work. No payment, however, final or otherwise, shall operate to release the Contractor or his Sureties from any obligation set forth in the Contract Documents, including any applicable performance, payment, maintenance bond or other type of bid security.

B. **Partial Payment**:

1. No claim by the Contractor for additional payment based on any error in any periodic estimate will be recognized.

2. The Commission may withhold payment for any of the following:

   a. Failure to submit a revised progress schedule, which has been approved by the Engineer, with each partial payment request.

   b. Defective work not corrected.

   c. Claims filed or responsible evidence indicating a reasonable probability of claims being filed.

   d. Failure of the Contractor to make proper payments to Subcontractor or for material or labor.

e. Unpaid damages by the Contractor to Subcontractor, the Commission, or any other agency or person.

f. In the judgment of the Engineer the project is not proceeding in accordance with the Contract or the Contractor is not complying with the requirements of the Contract Documents.

g. The Contractor is found in to be in default under the terms of the Contract.

3. No payment voucher shall protect the Contractor, and no claims shall be founded thereof by the Contractor in case of overpayment, or in case it shall at any time appear that the project or any part thereof has not been constructed, completed and maintained in strict accordance with the Contract Documents.

4. No interim voucher shall be held to signify the approval of permanent work, materials, or other things to which such certificate relates and the Contractor shall not be relieved by any such certificates from any risks of liability to which he may be subject under the Contract until final payment hereinafter referred to has been granted to it.

5. Errors in any monthly measurements or bill, on being discovered, will be rectified by the Engineer in subsequent measurements and bills.

6. If any work, the value of which has been included in any interim bill is damaged or destroyed and has to be removed or reconstructed by the Contractor, an amount representing the value of the work so damaged or destroyed, less any insurance monies therefore received by the Commission, will be deducted by the Engineer in succeeding partial payments until such time as work has been renovated or reconstructed.

7. State law requires that all claims for payments be approved by the governing body of the Commission. The Contractor shall allow six (6) to eight (8) weeks for receipt of partial payment after the payment has been approved by the Engineer.

Article XIII - MONEY MAY BE RETAINED:

The Commission may keep any monies which would otherwise be payable at any time hereunder, and apply the same, or so much as may be necessary therefore, to the payment of any expenses, losses or damages, as determined by the Engineer, incurred by the Commission which, pursuant to this Contract or the specifications shall be borne by the Contractor, and may retain until all claims shall have been settled so much of such monies as the Commission shall be of the opinion will be required to settle all claims against the

Commission and its officers and agents and all claims for labor on the work, and also all these claims for materials.

Article XIV – REPAIRS, BONDS, AND RETAINAGE:

A. The Contractor shall at its own cost, upon notification from the Commission or Engineer, promptly make good any and all defects, in its work, or that of any subcontractor employed by it hereunder, which may occur or appear during the progress of the work.

B. If, within ten (10) days after the delivery or mailing of notice in writing to the Contractor, or its agents, of the occurrence or appearance of any such fault in the work, the Contractor fails to remedy same, the Commission may remedy the same or cause it to be remedied without previous notice and/or in case of any emergency where, in the opinion of the Engineer, delay would cause serious loss or damage.

C. The cost of any defects so remedied or caused to be remedied by the Commission shall be borne solely by the Contractor, and any sum expended, or any expense so incurred by the Commission shall be deducted from any money then due or thereafter growing due from the Commission to the Contractor.

D. In order to secure the performance of the above, the Contractor shall furnish a **Performance and Payment Bond to the Commission** at the time of execution of this Contract, in the sum of one hundred percent (100%) of the Contract price. Said bond shall be in form and content satisfactory to the Commission.

E. Upon completion of the work hereunder and prior to its final acceptance by the Commission, the Contractor shall furnish the Commission with a **Maintenance Bond** in the amount of 100% of the Contract price which shall remain in full force and effect for a period of one year from the final date of acceptance of the work by the Commission. Said bond shall be in the form and content satisfactory to the Commission.

F. The Commission shall retain **five percent (5%)** of the total contract amount of money due for a period of **six (6) months** from the date of final acceptance of all of the work by the Commission, to be applied to any defects not remedied by the Contractor by the end of the six-month period.

Article XV - TERMINATION OF LIABILITY:

Upon acceptance by the Contractor, or his authorized agents, of the final payment under the provisions of this Contract, the project shall be considered completed and the Contractor shall have no further interest or claim whatever against the Commission or any of its officers or agents, except for amounts kept or retained or otherwise specifically provided herein.

Article XVI - STATUTORY COMPLIANCE:

The Contractor is required to comply with all applicable laws, regulations and ordinances.

Article XVII - BUY AMERICAN ACTS:

The Contractor and his subcontractors, if any, must comply with all "Buy American" statutes or regulations, including N.J.S.A. 52:33-1 et seq.

The Commission reserves the right to accept non-domestic materials under this contract in accordance with N.J.S.A. 52:33-2 and 52:33-3, in the event: (i) it determines the use of domestic materials is "impractical" or "inconsistent with the public interest"; (ii) it determines that the cost of using domestic materials is "unreasonable"; or (iii) domestic materials of the class or kind sought are not mined, produced, or manufactured, as the case may be, in the United States in commercial quantities and of a quality satisfactory to the Commission.

Article XVIII - AFFIRMATIVE ACTION:

The Contractor is required to comply with the requirements of N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27-1 et seq.

The Contractor shall complete and submit an Initial Project Workforce Report Form AA-201 upon notification of the contract award. Proper completion and submission of this report shall constitute evidence of the Contractor's compliance with the regulations. The Contractor shall also submit a copy of the Monthly Project Workforce Report Form AA-202 once a month thereafter for the duration of the Contract to the Division of Contract Compliance and Equal Employment Opportunity in Public Contracts in the Department of Treasury and to the Commission (the "Division").

Additionally, during the performance of this Contract, the Contractor agrees as follows:

The Contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation, the Contractor will take affirmative action to ensure that such applicants are recruited and employed, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment,

notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

The Contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex;

The Contractor or subcontractor, where applicable, will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer advising the labor union or workers' representative of the Contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The Contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the State Treasurer pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act. However, if a subcontractor has a total workforce of four (4) or fewer employees or if the Contractor or subcontractor is performing under an existing Federally approved or sanctioned affirmative action program, the contract shall contain only the mandatory language required by N.J.A.C. 17:27-3.8(a).

When hiring or scheduling workers in each construction trade, the Contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the applicable employment goal prescribed by N.J.A.C. 17:27-7.2; provided, however, that the Division may, in its discretion, exempt the Contractor or subcontractor from compliance with the good faith procedures prescribed by the following provisions, A, B and C, as long as the Division is satisfied that the Contractor or subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Division, that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the applicable employment goal established in accordance with N.J.A.C. 17:27-7.2.

The Contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:

A. If the Contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the Contractor or subcontractor shall, within three days of the contract award, seek assurances from the union that it will cooperate with the Contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to N.J.S.A. 10:531 et seq., as supplemented and amended from time to time and the Americans with Disabilities Act. If the Contractor or subcontractor is unable to obtain said assurances from the

construction trade union at least five (5) days prior to the commencement of construction work, the Contractor or subcontractor agrees to attempt to hire minority and women workers directly, consistent with the applicable employment goal. If the Contractor's or, subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with the applicable employment goal, the Contractor's or subcontractor's agrees to be prepared to hire or schedule minority and women workers directly, consistent with the applicable employment goal, by complying with the hiring or scheduling procedures prescribed under B below; and the Contractor or subcontractor further agrees to take said action if it determines or is so notified by the Division that the union is not referring minority and women workers consistent with the applicable employment goal.

B. If the hiring or scheduling of a workforce consistent with the employment goal has not or cannot be achieved for each construction trade by adhering to the procedures of (A) above, or if the Contractor does not have a referral agreement or arrangement with a union for a construction trade, the Contractor or subcontractor agrees to take the following actions consistent with the applicable county employment goals;

1. To notify the public agency compliance officer, the Division, and minority and women referral organizations listed by the Division pursuant to N.J.A.C. 17:27-5.3, of its workforce needs, and request referral of minority and women workers;

2. To notify any minority and women workers who have been listed with it as awaiting available vacancies;

3. Prior to commencement of work, to request the local construction trade union, refer minority and women workers to fill job openings, provided the Contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;

4. To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the Contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State training and Employment Service and other approved referral sources in the area until such time as the workforce is consistent with the employment goal;

5. If it is necessary to lay off some of the workers in a given trade on the construction site, to assure, consistent with the applicable State and Federal statutes and court decisions, that sufficient minority and women employees remain on the site consistent with the employment goal; and to employ any minority and women workers so laid off by the Contractor on any other construction site on which its workforce composition is not consistent with an employment goal established pursuant to rules implementing N.J.S.A. 10:5-31 et seq.;

6. To adhere to the following procedure when minority and women workers

apply or are referred to the Contractor or subcontractor;

i. If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the Contractor or subcontractor shall determine the qualifications of such individuals and if the Contractor's or subcontractor's workforce in each construction trade is not consistent with the applicable, employment goal, it shall hire or schedule those individuals who satisfy appropriate qualification standards. However, the Contractor or subcontractor shall determine that the individual at least possesses the requisite skills, and experience recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Division. If necessary, the Contractor or subcontractor shall hire or schedule minority and women workers who qualify as trainees pursuant to these rules. All of the requirements, however, are limited by the provisions of (C) below.

ii. If the Contractor's or subcontractor's workforce is consistent with the applicable employment goal, the name of any interested women or minority individual shall be maintained on a waiting list for the first consideration, in the event the Contractor's or subcontractor's workforce is no longer consistent with the applicable employment goal.

iii. If, for any reason, said Contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the Contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Division.

iv. The Contractor or subcontractor shall interview the referred minority or women workers.

7. To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Division and submitted promptly to the Division upon request.

C. The Contractor or subcontractor agrees that nothing contained in (B) above shall preclude the Contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the county employment goal, the Contractor or subcontractor shall consider for employment persons referred pursuant to (B) above without regard to such agreement or arrangement; provided further, however, that the Contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining

agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the Contractor or subcontractor agrees that, in implementing the procedures of (B) above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

After notification of award, but prior to signing a construction contract, the Contractor shall submit to the public agency compliance officer and the Division an initial project workforce report (Form AA 201) provided to the public agency by the Division for distribution to and completion by the Contractor, in accordance with N.J.A.C. 17:27-7. The Contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this Contract to the Division and to the Public Agency Compliance Officer.

D. The Contractor and its subcontractors shall furnish such reports or other documents to the Division of Contract compliance & EEO as may be requested by the Division from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Division of Contract Compliance & EEO for conducting a compliance investigation pursuant to Subchapter 10 of the Administrative Code at N.J.A.C. 17:27-1 et seq.

Article XIX - WORKER AND COMMUNITY RIGHT-TO-KNOW ACT (N.J.S.A. 34:5A-1 et seq.; N.J.A.C. 7:1G):

This Act requires employers to label all containers of hazardous substances. All goods offered for purchase to the Commission must be labeled in compliance with the provisions of this Act.

Material Safety Data Sheets also must be supplied as is required by law.

Article XX - SAFETY:

All equipment and work methods utilized in this Contract shall comply with O.S.H.A. and any other applicable local, State and Federal safety standards and regulations.

Article XXI – TAX EXEMPTION:

Purchases made by the Commission are exempt from payment of state sales taxes, and such tax shall not be included in the price for the work for the project.

Article XXII – DISPUTE RESOLUTION:

A. **NOTICE** – Written notice stating the general nature of each Claim, dispute, or other matter shall be delivered by the Contractor to the Commission's Executive Director promptly (but in no event later than thirty (30) days) after the start of the event giving

rise thereto. Notice of the amount or extent of the claim, dispute, or other matter with supporting data shall be delivered to the Commission's Executive Director within sixty (60) days after the start of such event (unless the Executive Director allows additional time to submit additional or more accurate data in support of such Claim, dispute, or other matter). Any claim for an adjustment in Contract price and/or Contract time shall be prepared in accordance with the provisions of an official change order or contract amendment approved by the Board of Commissioners. Each Claim shall be accompanied by the Contractor's written statement that the adjustment claimed is the entire adjustment to which the Contractor believes it is entitled as a result of said event. The Commission will respond to the Contractor within sixty (60) days after receipt of the Contractor's last submittal.

B. APPEAL FROM BOARD OF COMMISSIONER'S DECISION – The Contractor may appeal the Board of Commissioner's decision rendered pursuant to the above Notice by delivering to the Commission within thirty (30) days after the date of such decision, a written notice of intention to appeal. The date of receipt of such notice by the Board of Commissioner's shall be the date upon which the time periods in these dispute resolution proceedings are calculated.

C. WORK CONTINUANCE AND PAYMENT – Unless otherwise agreed in writing, the Contractor shall continue to work, furnish required equipment and maintain the Schedule of the Work as outlined in the contract specifications during any dispute resolution proceedings. If Contractor continues to perform per the contract specifications, the Commission shall continue to make payments in accordance with this Contract.

D. INITIAL DISPUTE RESOLUTION – Upon issuance of a written notice of intention to appeal, the parties shall endeavor to settle the dispute first through direct discussions. The senior executives of the parties, who for the Contractor shall have the authority to settle the dispute and for the Commission shall be the Executive Director, shall meet within twenty-one (21) days after the date of receipt by the Commission of the notice of intention to appeal**.** If the dispute is not settled within thirty (30) days from the referral of the dispute to the senior executives, the parties shall submit the dispute to mediation in accordance with Paragraph E.

E. MEDIATION – If the dispute cannot be settled pursuant to Paragraph D, the parties shall endeavor to settle the dispute by mediation under the current Construction Industry Mediation Rules of the American Arbitration Association before recourse to any other dispute resolution procedures. Once one party files a request for mediation with the other party and with the American Arbitration Association, the parties agree to conclude such mediation within one hundred twenty (120) days of filing of the request.

The Commission and the Contractor shall cooperate with American Arbitration Association and with each other in selecting a mediator from American Arbitration Association, panel of neutrals and in scheduling the mediation proceedings. The

Commission and the Contractor shall participate in the mediation in good faith, and shall share equally in its costs. All communications, documents, and other materials, whether written or oral, made in the course of or relating to the mediation by the Commission or the Contractor, or their agents, employees, experts or attorneys, or by the mediator or American Arbitration Association, employees, are confidential and privileged, and inadmissible for any purpose in any court, administrative, or other proceeding, provided that evidence that is otherwise admissible or discoverable shall not be rendered inadmissible or non-discoverable as a result of its use in the mediation. This agreement to mediate and any other agreement or consent to mediate entered into in accordance herewith as provided herein will be specifically enforceable under the laws of the State of New Jersey.

Either party may terminate the mediation at any time after the first session but the decision to terminate shall be delivered in person by the party's representative to the other party's representative and the mediator.

F. MULTIPARTY PROCEEDINGS – All parties necessary to resolve a claim or dispute shall be parties to the same dispute resolution proceeding. Appropriate provisions shall be included in all other contracts relating to the work in accordance with the Contract to provide for the consolidation of such dispute resolution procedures.

G. CONCLUSION OF MEDIATION – In the event that mediation is concluded without a resolution of the dispute, Contractor and Commission may exercise such rights and remedies as either may otherwise have under the Contract Documents or by applicable law in respect of any dispute.

H. If, in the sole opinion of the Commission, a dispute arises which imperils the timely completion of the work, an excessive increase in costs, a substantial risk of harm to the public health or welfare, or an emergency or exigency which must be addressed immediately, then the Commission may institute court, administrative, or other proceedings without prior compliance with the dispute resolution provisions contained in this Contract.

ARTICLE XXIII – COMPLIANCE WITH COMMISSION CONTRACT AWARD POLICIES:

Contractor represents and warrants that it has not made any contribution that would bar the Commission from awarding the Contractor this Contract pursuant to the contract award policies adopted by the Commission and set forth in the Commission's Accounting Policies and Procedures Manual. Contractor shall have a continuing duty to report any contribution it makes during the term of this Contract. Consistent with the requirements of the Commission's contract award policies, the Contractor acknowledges that it is prohibited from being awarded this Contract if Contractor has solicited or made any contribution of money, or pledge of contribution, including in-kind contributions to a candidate committee and/or election fund of any candidate or holder of the public office of Governor, or to any State or county political party committee: (i) within the eighteen

(18) months immediately preceding the commencement of negotiations for the contract or agreement; (ii) during the term of office of a Governor, in the case of contributions to a candidate committee and/or election fund of the holder of that office, or to any State or county political party committee of a political party nominating such Governor in the last gubernatorial election preceding the commencement of such term; or (iii) within the eighteen (18) months immediately preceding the last day of the term of office of Governor, in which case such prohibition shall continue through the end of the next immediately following term of the office of Governor, in the case of contributions to a candidate committee and/or election fund of the holder of that office, or to any State or county political party committee of a political party nominating such Governor in the last gubernatorial election preceding the commencement of the latter term.

It shall be a breach of the terms of this contract for Contractor to: (i) make or solicit a contribution in violation of either this subsection or the Commission's contract award policies; (ii) knowingly conceal or misrepresent a contribution given or received; (iii) make or solicit contributions through intermediaries for the purpose of concealing or misrepresenting the source of the contribution; (iv) make or solicit any contribution on the condition or with the agreement that it will be contributed to a campaign committee of any candidate or holder of the public office of Governor, or to any State or county party committee; (v) engage or employ a lobbyist or consultant with the intent or understanding that such lobbyist or consultant would make or solicit any contribution, which if made or solicited by the business entity itself, would subject that entity to the restrictions of this subsection; (vi) fund contributions made by third parties, including consultants, attorneys, family members, and employees; (vii) engage in any exchange of contributions to circumvent the intent of this subsection or Executive Order; or (viii) directly or indirectly, through or by any other person or means, do any act which would subject that entity to the restrictions of this subsection.

Contractor is advised of the responsibility to file an annual statement on political contributions with the New Jersey Election Law Enforcement Commission pursuant to N.J.S.A. 19:44A-20.13 (P.L. 2005, c.271, s.3) if the Contractor receives contracts in excess of $50,000 from public entities in a calendar year. It is the Contractor's responsibility to determine if filing is necessary. Additional information on this requirement is available from ELEC at 888-313-3532 or at www.elec.state.nj.us.

Article XXIV – BUSINESS REGISTRATION CERTIFICATE

A. Business Registration: Pursuant to N.J.S.A. 52:32-44, **NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION** is prohibited from entering into a contract with an entity unless the bid/proposal/contractor, and each subcontractor that is required by law to be named in a bid/proposal/contract has a valid Business Registration Certificate on file with the Division of Revenue and Enterprise Services within the Department of Treasury.

B. Prior to contract award or authorization, the Contractor shall provide the

Commission with its proof of business registration and that of any named subcontractor(s).

C. Subcontractors named in a bid or other proposal shall provide proof of business registration to the Contractor, who in turn, shall provide it to the Commission prior to the time the Contract, purchase order or other contracting documents is awarded or authorized.

D. During the course of contract performance:

(1) the Contractor shall not enter into a contract with a subcontractor unless the subcontractor first provides the Contractor with a valid proof of business registration.

(2) the Contractor shall maintain and submit to the Commission a list of subcontractors and their addresses that may be updated from time to time.

(3) the Contractor and any subcontractors providing goods or performing services under the Contract, and each affiliates, shall collect and remit to the Director of Division of Taxation in the Department of Treasury, the use tax due pursuant to the Sales and Use Tax Act, (N.J.S.A. 54:32B-1 et.seq.) on all sales of tangible personal property delivered to the State. Any questions in this regard can be directed to the Division of Taxation at (609)2925-6200. Form NJ-REG can be filled out at www.state.nj.us/treasury/revenue/busregcert.html.

E. Before final payment is made under the Contract, the Contractor shall submit to the Commission a complete list of all subcontractors and their addresses.

F. Pursuant to N.J.S.A. 54:49-4.1, a business organization that fails to provide a copy of a business registration as required, or that provides false business registration information, shall be liable for a penalty of $25 for each day of violation, not to exceed $50,000, for each proof of business registration not properly provided under a contract with a contract agency.

Article XXV – PUBLIC CONTRACTOR REGISTRATION

N.J.S.A. 34:11-56.48 et seq., requires that a general or prime contractor and any listed subcontractors named in the contractor's bid proposal shall possess a certificate at the time the bid proposal is submitted. After the bid proposal is received and prior to award of contract, the Contractor shall submit a copy of the contractor's certification along with those

of all listed subcontractors. All non-listed subcontractors and lower tier subcontractors shall be registered prior to starting work on the project. It is the general contractor's responsibility that all non-listed subcontractors at any tier have their certificate prior to starting work in accordance with this Contract .

Under the law a "contractor" is "a person, partnership, association, joint stock company, trust, corporation or other legal business entity or successor thereof who enters into a contract" which is subject to the provisions of the New Jersey Prevailing Wage Act (N.J.S.A. 34:11-56.25, et seq.) It applies to contractors based in New Jersey or any other state.

To register, a contractor must provide the State Department of Labor with a full and accurately completed application form. The form is available online at www.state.nj.us/labor/lsse/lspubcon.html. N.J.S.A. 34:11-56.55 specifically prohibits accepting applications for registration as a substitute for a certificate of registration.

ARTICLE XXVI – NEW JERSEY ANTI-DISCRIMINATION

Pursuant to N.J.S.A. 10:2-1, the Contractor agrees that:

a. In the hiring of persons for the performance of work under this Contract or any subcontract hereunder, or for the procurement, manufacture, assembling or furnishing of any such material, equipment, supplies or services to be acquired under this Contract, no contractor, nor any person acting on behalf of such contractor or subcontractor , shall, by reason of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex, discriminate against any person who is qualified and available to perform the work to which the employment relates;

b. No contractor, subcontractor, nor any person on his behalf, shall in any manner, discriminate against or intimidate any employee engaged in the performance of work under this Contract or any subcontract hereunder, or engage in the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under such contract, on account or race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex;

c. There may be deducted from the amount payable to the Contractor by the Commission , under this Contract, a penalty of $50.00 for each person for each calendar day which such a person is discriminated against or intimidated in violation of the provisions of the Contract; and

d. This Contract may be canceled or terminated by the Commission , and all money due to become due hereunder may be forfeited, for any violation of this section of the Contract occurring after notice to the Contractor from the Commission of any prior violation of this section of the Contract.

Article – XXVII AMERICAN WITH DISABILITIES ACT 1990

The Contractor and the Commission do hereby agree that the provisions of Title 11 of the Americans with Disabilities Act of 1990 (the "Act") *(42 U.S.C. S121 01 et seq.),* which prohibits discrimination on the basis of disability by public entities in all services, programs, and activities provided or made available by public entities, and the rules and regulations promulgated pursuant there unto, are made part of this Contract. In providing any aid, benefit, or service pursuant to this Contract, the Contractor agrees that the performance shall be in strict compliance with the Act. In the event that the Contractor, its agents, servants, employees, subcontractors violate or are alleged to have violated the Act during the performance of this Contract, the Contractor shall defend the Commission in any action or administrative proceeding commenced pursuant to the Act. The Contractor shall indemnify, protect, and save harmless the Commission , it agents, servants, and employees from and against any and all suits, claims, losses, demands, or damages, of whatever kind of nature arising out of or claimed to arise out of the alleged violation. The Contractor shall, at its own expense, appear, defend, and pay any and all charges for legal services and any and all costs and other expenses arising from such action or administrative proceeding or in connection therewith. In any and all complaints brought pursuant to the Commission's grievance procedure, the Contractor agrees to abide by any decision of the Commission which is rendered pursuant to said grievance procedure. If any action or administrative proceeding results in an award of damages against the Commission , or if the Commission incurs any expense to cure a violation of the ADA which has been brought pursuant to its grievance procedure, the Contractor shall satisfy and discharge the same at its own expense.

The Contractor shall, as soon as practicable after a claim has been made against it, give written notice thereof to the Contractor along with full and complete particulars of the claim, if any action or administrative proceeding is brought against the Commission or any of its agents, servants, employees, the owner shall expeditiously forward to the Contractor every demand, complaint, notice, summons, pleading, or other process received by the Commission or its representatives.

It is expressly agreed and understood that any approval by the Commission of the services provided by the Contractor pursuant to this Contract will not relieve the Contractor of the obligation to comply with the Act and to defend, indemnify, protect, and save harmless to the pursuant to this paragraph.

It is further agreed and understood that the Commission assumes no obligation to indemnify

or save harmless the Contractor, its agents, servants, employees and subcontractors for any claim which may arise out of their performance of this Contract. Furthermore, the Contractor expressly understands and agrees that the provisions of this indemnification clause shall in no way limit the Contractor's obligations assumed in this Contract, nor shall they be construed to relieve the Contractor from any liability, nor preclude the Commission from taking any actions available to it under any other provisions of the Contract or otherwise at Law.

Article XXVIII – DISCLOSURE OF INVESTMENT ACTIVITIES IN IRAN

Pursuant to Public Law 2012, c. 25, the Contractor shall complete the certification attached hereto to attest, under penalty of perjury, that neither the person or entity, nor any of its parents, subsidiaries, or affiliates, is identified on the Department of Treasury's Chapter 25 list as a person or entity engaging in investment activities in Iran. The Chapter 25 list is found on the Division's website at http://www.state.nj.us/treasury/purchase/pdf/Chapter25List.pdf. The Contractor must review this list prior to completing the below certification. If the Director finds a person or entity to be in violation of law, s/he shall take action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the party.

Certification of Non-Involvement in Prohibited Activities in Russia or Belarus.

Pursuant to Public Law 2022,c.3, the Contractor must complete the certification attached hereto to attest, under penalty of perjury, that neither the person or entity, nor any of its parents, subsidiaries, or affiliates, is identified as a person or entity engaging in prohibited activities in Russia or Belarus as such terms is defined in P.L. 2202.c.3, section1.e, except as permitted by federal law.

Article XXIX - DIANE B. ALLEN EQUAL PAY ACT

Pursuant to N.J.S.A. 34:11-56.14, a contractor performing "qualifying services" or "public work" to the State or any agency or instrumentality of the State shall provide the Commissioner of Labor and Workforce Development a report regarding the compensation and hours worked by employees categorized by gender, race, ethnicity, and job category. For more information and report templates see https://nj.gov/labor/equalpay/equalpay.html.

Article XXX - Disabled Veteran-Owned Business Set-Aside

In accordance with the New Jersey Set-Aside Act for Disabled Veterans' Businesses, N.J.S.A. 52:32-31.1 et seq. (P.L. 2015, c. 116), it is the policy of the

Commission that Disabled Veteran-Owned Businesses ("**DVOBs**"), as determined and defined by the State of New Jersey, Department of Treasury, Division of Revenue and Enterprise Services in N.J.A.C. 17:14-1.1 et seq. (the "**Division**"), have the opportunity to compete for and participate in the performance of contracts and subcontracts for construction services. The Commission further requires that its Contractors shall agree to take all necessary and responsible steps, in accordance with the aforementioned regulations, to ensure that DVOBs have these opportunities. The Contractor is encouraged to obtain a complete copy of the applicable regulations (N.J.A.C. 17:14-1.1 et seq.) prior to submitting bids to the Commission.

The Contractor agrees to make a good faith effort to award at least 3% of this Contract to Subcontractors registered by the Division as a DVOB firm. Subcontracting goals do not apply if the prime Contractor is a registered DVOB firm.

The following actions shall be taken by a bidder in establishing a good faith effort to solicit and award subcontracts to eligible disabled veteran-owned businesses, as established in the RFP:

5) The bidder shall attempt to locate qualified potential disabled veteran-owned business subcontractors;

6) The bidder shall consult the disabled veteran business database if none are known to the bidder;

7) The bidder shall keep a record of its efforts, including the names of businesses contacted and the means and results of such contacts, as well as documentation on any good faith efforts to solicit and award any subcontract to an eligible disabled veteran-owned business; and

8) The bidder shall provide all potential subcontractors with detailed information regarding the specifications.

In those circumstances where Federal law, rules, or regulations permit or require a procurement procedure other than those prescribed in this chapter, the State contracting agency shall follow the Federal procedures notwithstanding the provisions of this chapter, provided that the State contracting agency issues a written declaration that such Federal laws, rules, or regulations are in effect.

The Commission requires that DVOB Forms A, B, C, D, and F as applicable, be submitted within seven (7) days after Notice of Award. However, the Commission may extend the deadline for this requirement at its sole discretion.

If the Contractor submits the DVOB forms within the requested timeframe, but fails to meet the DVOB goal, a fully completed and notarized DVOB Form D must be submitted, and the Commission will evaluate the efforts made by the Contractor to determine whether a demonstration of good faith efforts has been made.

The listing of a DVOB firm by a Contractor on Form A shall constitute a representation by the Contractor to the Commission that such DVOB firm is qualified and available, and a commitment by the Contractor that it will enter into a subcontract with such DVOB firm for the portion of the work described in Form A and at the price set forth in its Bid. A DVOB Contractor which lists itself on Form A is committed to performing the work indicated with its own personnel.

A database of DVOBs is maintained by the State, accessible via a link on the Division's webpage at https://www20.state.nj.us/TYTR_SAVI/vendorSearch.jsp; the database lists vendors by designation, including DVOBs, and is available for use by State contracting agencies and others in confirming eligibility for set-aside contracts and subcontracts and in reporting progress toward established contract award goals. Use of this listing does not relieve the Contractor of its responsibility to seek DVOB participation from other sources.

Whenever the Commission issues Project Change Orders, the Commission may determine if increased DVOB participation will be required.

If at any time the Contractor believes or has reason to believe that a proposed DVOB has become unavailable or, due to change in ownership or management responsibility, does not meet the applicable standards, the Contractor shall, within 10 days, notify the Commission of that fact. Within 15 days thereafter, the Contractor shall, if necessary to achieve the stated goal, make every reasonable effort to subcontract the same or other work to other DVOB firms.

Should a DVOB become ineligible during the course of this Contract, effective as of the date of ineligibility, further contractual dollars expended with the DVOB shall not be counted toward the DVOB goal. Within 15 days after notification by the Commission to the Contractor of the ineligible DVOB, the Contractor will make every reasonable effort to satisfy the DVOB goal. The Contractor's effort to continue to meet the DVOB goal shall be coordinated with the Office of EEO.

GENERAL CONDITIONS

To ensure that all obligations under subcontracts awarded to DVOBs are met, the Commission shall review the prime Contractor's DVOB involvement efforts during the performance of the contract. The Contractor shall monitor the performance of and collect and report data on DVOB participation to the **Office of EEO**. The form will be reviewed to determine Contract compliance with respect to the DVOB goal. Failure to submit this report may result in suspension of payments as provided in the section titled "Audit and Penalties" below. If, at any time, the Commission has reason to believe that any person or firm has willfully and knowingly provided incorrect information or made false statements, it shall refer the matter to the Attorney General of the State of New Jersey.

The Contractor agrees to pay each subcontractor and supplier for satisfactory performance of its subcontract no later than ten (10) days from the receipt of each payment the Contractor receives from the Commission.

In accordance with N.J.S.A. 52:32-40 and 52:32-41, the Contractor shall certify, prior to the issuance of a progress payment by the Commission, that all subcontractors and suppliers have been paid any amounts due from previous progress payments and shall be paid any amounts from the current progress payment. Alternatively, the Contractor shall certify that there exists a valid basis under the terms of the subcontract to withhold payment from the subcontractor or supplier and therefore payment is withheld.

If the Contractor withholds payment from the Subcontractor or supplier, the Contractor shall provide to the Subcontractor or supplier written notice thereof. The notice shall detail the reason for withholding payment and state the amount of payment withheld. The Contractor shall send a copy of the notice to the Surety of the Contract Bond. A copy of the notice shall also be submitted to the Commission with the certification that payments are being withheld.

Except as provided herein, the Contractor shall not have the work performed, or the materials or supplies furnished, by any other DVOB firm other than those named in Form A. However, the Contractor may, in unusual situations, be permitted to substitute a subcontractor(s). A request for substitution must be in writing, with complete justification for the request. The Contractor must have approval of the Commission before substitution of the DVOB subcontractor, regardless of the reason for the substitution. Failure to obtain approval from the Commission could result in the prime Contractor being found to be in "noncompliance" with the requirements of the contract. The term "unusual situations" includes, but is not limited to, a DVOB subcontractor or DVOB joint venture partner(s):

9) Failure to qualify as a DVOB or maintain DVOB registration status.
10) Death or physical disability, if the named subcontractor or DVOB partner of the joint venture is an individual.

11) Dissolution, if a corporation or partnership.
12) Bankruptcy of the subcontractor, subject to applicable bankruptcy laws, and only in instances where the bankruptcy affects the subcontractor's ability to perform.
13) Inability to obtain, or loss of, a license necessary for the performance of the particular category of work.
14) Failure or inability to comply with a requirement of law applicable to the subcontract work.
15) Material failure to comply with the terms and conditions of the subcontract.
16) Material failure to successfully perform the subcontract tasks.

The prime Contractor is advised that failure to carry out the requirements of these specifications shall constitute a breach of contract and may result in termination of the contract by the Commission, or such remedy as the Commission deems appropriate. During the performance of the contract, and for a period of up to three (3) years following completion of the contract work, the Commission may conduct reviews for compliance with the requirements of the DVOB Program. Such reviews may include the evaluation of monthly reports, desk audits, and site visitations. Where a Prime Contractor, or any Subcontractor, is found to be in noncompliance with the requirements of the DVOB Program during the performance of the contract, it will be required to take corrective action. If corrective action is not promptly taken by the offending contractor, the following sanctions may be instituted (singularly, in any combination and in addition to any other remedies provided by law):

5) The Commission may withhold further payments under the Contract.
6) The Contract may be terminated for breach.
7) Suspension or debarment proceedings may be commenced in accordance with New Jersey law and the Commission regulations.
8) The Contract Bond may be enforced.

Copies of the following forms are located on the Commission website*:*

(g) Commission Form A: DVOB Participation Schedule:
List all DVOB firms scheduled to participate in the contract, including scope of work to be performed and the dollar value of their anticipated participation. Additionally, the name of the Contractor's DVOB liaison officer should be included on this form. Upon execution of a contract with the Commission the prime contractor must enter into a formal agreement with the DVOB(s) listed on Form A. There can be no substitution of the DVOB(s) listed on Form A without the prior written approval of the Commission. If, for any reason Form A is not completed, then the Contractor must complete and provide Form D (see below).

(h) Commission Form B: Affidavit of DVOB (If Applicable):

For each DVOB owned firm listed on Form A, Contractor shall include a complete and signed Form B. This form B is not required for set aside contract awards, nor in cases wherein the Contractor is a DVOB itself.

(i) Commission Form C: Affidavit of DVOB (If Applicable):
Each DVOB firm to be utilized must sign Form C attesting to its status as a DVOB.

(j) Commission Form D: DVOB Unavailability Certification (If Applicable):
If the Contractor is unable to identify DVOB(s) as required to meet the targeted goal set for this Contract, the Contractor shall complete and attach this form which documents the Contractor's good faith efforts to do so.

(k) Commission Form E: DVOB Certificate of Participation:
This is the payment report that must be completed on a monthly basis by the Contractor, unless the Contractor is a DVOB itself.

(l) Commission Form F: DVOB Certificate of Participation if Prime Contractor
is DVOB): If the Contractor is a DVOB itself, the Contractor shall complete this form and attach it with every Pay Estimate.

Article XXXI – SAFETY MEASURES

All equipment and work methods utilized in this Contract shall comply with OSHA and all other applicable local, state and/or federal safety standards and regulations. Contractor and all subcontractors shall be required to attend a general Contract Safety Orientation prior to beginning construction.

Article XXXII – SECURITY MEASURES

The following measures must be adhered to as it relates to this contract:

1. The Contractor shall furnish a complete description of all equipment and vehicles that will enter onto Commission property. All equipment and vehicles will have ID or plate/tag numbers easily visible.

2. As required by the New Jersey Office of Counter Terrorism's Best Management Practices, Contractors must provide evidence that it has previously conducted a background check on all Contractor's employees who will be entering onto Commission property. Contractors shall provide the Commission with a corporate

letter, on appropriate letterhead, stating the names of all employees who will require access to the Commission's property, and indicating that such background checks have, in fact, been performed. All subcontractors are also required to provide such employee list, and confirmation of background checks.

NO ONE WILL BE ALLOWED ONTO COMMISSION PROPERTY WITHOUT PRIOR APPROVAL.

3. No specialized individuals will be allowed onto Commission property without being previously approved. This includes mechanics, fuel deliveries, sanitary facility maintenance, etc. The **"Access Approval Form to Commission Facilities"** (Attachment #1) must be filled out completely, with a copy of **GOOD QUALITY PHOTO ID**, and submitted to the Commission at least **twenty-four (24) hours** prior to arrival. This form **MUST** be completed for **every** visit or delivery. Liquid delivery may be subject to sampling prior to entering onto Commission property. The Contractor shall make no claim against the Commission for loss of time associated with complying with this requested time frame.

4. Only the approved Contractor's employees and employees of any subcontractor listed by the Contractor on **page (I-25)** of the Bid Documents, and approved equipment will be allowed on Commission property.

5. Vehicles entering onto Commission property shall be subject to search.

NOTE: THE COMMISSION SHALL HAVE THE RIGHT TO EXPAND SECURITY REQUIREMENTS AND CONTRACTOR SHALL MAKE NO CLAIMS AGAINST THE COMMISSION FOR INCREASED SECURITY REQUIREMENTS MADE DURING THE LIFE OF THIS CONTRACT.

Article XXXIII – PROMPT PAYMENT OF CONSTRUCTION CONTRACTS ACT

On September 1, 2006, the New Jersey Legislature passed the Prompt Payment of Construction Contracts Act, P.L. 2006, c.96.

GENERAL CONDITIONS

P.L. 2006, c.96, provides, in part, as follows: If a prime contractor has performed in accordance with the provisions of a contract with the Commission and the billing for the work has been approved and certified by the Commissionor the Commission's authorized approving agent, the Commission shall pay the amount due to the prime contractor for each periodic payment, final payment or retainage monies not more than thirty (30) calendar days after the billing date, which for a periodic billing, shall be the periodic billing date specified in the Contract. The billing shall be deemed approved and certified twenty (20) days after the Commission receives it unless the Commission provides, before the end of the 20-day period, a written statement of the amount withheld and the reason for withholding payment, except that in the case of a public or governmental entity that requires the entity's governing body to vote on authorizations for each periodic payment, final payment or retainage monies, the amount due may be approved and certified at the next scheduled public meeting of the entity's governing body, and paid during the entity's subsequent payment cycle, provided this exception has been defined in the bid specifications and contract documents.

As a public entity that requires the authorization of its governing body for periodic or final payments, and payments for change orders or release of retainage, the Commission hereby places the prime contractor on notice that it not subject to the twenty (20) day period for the approval and certification of billings and, consistent with P.L. 2006, c. 96, in the event that the Commission is unable to obtain formal consideration and approval of any billing for work performed by a prime contractor as the basis for a periodic or final payment, or payments for change orders or retainage within the thirty (30) day time period mandated by P.L. 2006, c.96, the Commission shall place the billing for work performed on its next regularly scheduled meeting of its Board of Commissioners and, should such billing for work performed be approved, pay the approved amount to the prime contractor during the Commission's subsequent payment cycle.

Article XXXIV – CONFIDENTIALITY & NON-DISCLOSURE REQUIREMENTS:

The Contractor shall hold in trust and not reveal to any third party, except as provided in this Contract, between the Commission and the Contractor, any and all confidential or "Security Related" information as defined herein. The Contractor shall require its employees and sub-contractors to comply with the provisions of this Contract, if applicable, as it pertains to confidentiality. This Section must be included in all subcontracts entered into by the Contractor. Confidential or "Security Related" information shall include:

- Any and all financial, statistical, personnel and/or technical data supplied to the Contractor.
- Any and all data, technical information, material gathered, originated, developed, prepared, used or obtained in the performance of this Contract, including results and opinions of the Contractor.
- Any and all communications between the Commission and the Contractor and the Contractor and any third party regarding the performance of this Contract.

The Contractor is required to protect the confidentiality of such data. Any use, copying, distribution, sale or offering of this data in any form by the Contractor, or any individual or entity in the Contractor's charge or employ for purposes not connected with this Contract, will be considered a violation of this Contract and may result in contract termination and the Contractor's suspension or debarment from State contracting. In addition, such conduct may be reported to the State Attorney General for criminal prosecution to the extent allowed by law.

It is further agreed that any information supplied by the Commission to the Contractor and any information developed by the Contractor in satisfaction of the Scope of Work within this Contract is subject to the following conditions and restrictions:

- Information received from or developed for the Commission is to be used solely for the purpose(s) established in this Contract.

- The data confidentiality matters coming within this Contract shall continue beyond the completion of all work involved in this Contract, unless specifically waived in writing by the Commission.

Article XXXV – GENERAL WARRANTY & GUARANTEE:

A. In addition to other promises and warranties contained herein, the Contractor warrants that the labor and materials to be furnished and installed under this Contract will be new and free from defects in material and workmanship for a period of **one year from the date of completion by the Contractor**. This warranty excludes damage or defect caused by abuse, modification, normal wear and tear, or improper maintenance or operation by persons other than the Contractor, its employees, subcontractors, or any other individual the Contractor utilizes to discharge its obligations under this Contract. In the event that the Commission determines, in its sole discretion, that the equipment furnished by the Contractor has failed prematurely or contains a defect in material or workmanship, then the Contractor shall repair or replace said defective free of charge and install said equipment free of charge. The Contractor shall proceed to remedy such defects in material and workmanship within seven (7) days of receipt of written notice from the Commission. All such replacement parts shall be shipped F.O.B., Commission's site.

B. The Contractor's obligation to perform and complete the work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of the work that is not in accordance with the Contract Documents or a release of the Contractor's obligation to perform the work in accordance with the Contract Documents:

1. Observations by the Commission;

2. The making of any milestone or final payment;
3. The issuance of a certificate of Substantial Completion;
4. Use or occupancy of the work or any part thereof by the Commission;
5. Any review and approval of a Submittal;
6. Any inspection, test, or approval by others; or
7. Any correction of defective construction by the Commission.

Article XXXVI– APPLICABLE LAW:

This Contract shall be governed by the laws of the State of New Jersey without giving effect to principles of conflicts of law.

Article XXXVII – TERMINATION:

This Contract may be terminated by the Commission, with or without cause, upon three (3) days written notice to the Contractor. In the event of termination of this Agreement, the Commission shall only be responsible to pay the Contractor compensation for the services rendered up to the date of the Contractor's receipt of written notice of termination.

Article XXXVIII – NOTICES:

All notices, requests, demands and other communication provided for by this Contract shall be in writing and shall be deemed to have been given when mailed at any general branch United States Post Office enclosed in a certified postpaid envelope and addressed to the address of the respective party stated herein or to such changed address as the party may have fixed by notice.

Article XXXIX– NON-WAIVER:

No delay or failure by either party in exercising any right under this Contract, and no partial or single exercise of that right, shall constitute a waiver of that or any other right.

Article XL– COUNTERPARTS:

This Contract may be executed in two (2) or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

CONTRACT #2112

GENERAL CONDITIONS

SIGNATURES ON THE FOLLOWING PAGE

CONTRACT #2112
CERTIFICATE OF ACKNOWLEDGMENT
FOR CONTRACTOR (CORPORATION)

IN WITNESS THEREOF, the parties hereto have caused this Contract to be duly and properly executed in duplicate this _____ day of _____ , 2023 copy, thereof to remain with the Commission and one to be delivered to the Contractor.

NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION

BY: _____
DR. HOWARD L. BURRELL, **CHAIRMAN**

ATTEST:

_____
KIM DIAMOND, COMMISSION SECRETARY

(CONTRACTOR)

BY: _____
(SIGNATURE)

_____
(TYPED SIGNATURE)

_____
(TITLE)

ATTEST/WITNESS:

***** _____ ***(*Witness must also complete page C-32)***
(SIGNATURE)

_____
(TYPED SIGNATURE)

_____
(TITLE)
SEAL:

C-31

CONTRACT #2112
CERTIFICATE OF ACKNOWLEDGMENT
FOR CONTRACTOR (CORPORATION)

STATE OF **}**
S.S.
COUNTY OF **}**

BE IT REMEMBERED, that on this _____ day of _____, 2023 before me, a Notary Public of the State of_____personally appeared *_____ (Witness), who, being duly sworn, doth depose and make proof to my satisfaction, that he/she well knows the corporate seal of _____ Contractor named in the foregoing contract, that the seal affixed is the proper corporate seal of said Contractor, that the same was so affixed thereto and the said contract signed by _____who was at the date and execution thereof, the _____ of said company, in the presence of said deponent, as the voluntary act and deed of said company, and that the said deponent thereupon signed the same as subscribing witness.

_____ *_____
NOTARY PUBLIC WITNESS' SIGNATURE

SWORN AND SUBSCRIBED TO BEFORE _____
TYPED SIGNATURE

ME THIS _____ DAY OF

_____, 2023. _____
TITLE

Please note – this page must be completed by the person who attested/witnessed the execution of the contract on page C-31.

CONTRACT #2112

CERTIFICATE OF ACKNOWLEDGEMENT
FOR CONTRACTOR (INDIVIDUAL)

STATE OF **}**
S.S.
COUNTY OF **}**

BE IT REMEMBERED, that on this _____ day of_____ ,2023 before me a Notary Public of the State of _____ personally appeared who being by me duly sworn, doth depose and make proof to my satisfaction, that he (she) is the Contractor named in the foregoing contract, and the said contract signed by him (her) voluntary act and deed.

(CONTRACTOR)

_____

_____
(TYPED SIGNATURE)

_____
NOTARY PUBLIC:

SWORN AND SUBSCRIBED TO BEFORE

ME THIS _____ DAY OF

_____ 2023.

CONTRACT #2112

CERTIFICATE OF ACKNOWLEDGEMENT
FOR COMMISSION

STATE OF **}**
S.S.
COUNTY OF **}**

BE IT REMEMBERED, that on this _____ day of _____, 2023 before me personally appeared **KIM DIAMOND**, (Commission Secretary) who being by me duly sworn, doth depose and make proof to my satisfaction, that she well knows the corporate seal of the North Jersey District Water Supply Commission, the Commission named in the foregoing contract, that the seal thereto affixed is the proper corporate seal of said Commission, that the same was so affixed thereto and the said contract signed by **DR. HOWARD L. BURRELL**, who was at the date and execution thereof, the Chairman of the North Jersey District Water Supply Commission, in the presence of the said deponent, as the voluntary act and deed of the said Commission, and that the said deponent thereupon signed the same as subscribing witness.

_____
KIM DIAMOND, COMMISSION SECRETARY

_____
NOTARY PUBLIC:

SWORN AND SUBSCRIBED TO BEFORE

ME THIS _____ DAY OF

_____ 2023

EXHIBIT "A"

TECHNICAL SPECIFICATIONS

WANAQUE SOUTH PUMP STATION HVAC REPLACEMENT

NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION WANAQUE, NJ

SPECIFICATIONS

Prepared by:
DLB Associates Consulting Engineers, P.C.
3600 Route 66 – Suite 150 - #5981
Neptune, NJ 07753

(DLB # 12636)

ISSUED FOR BID AND CONSTRUCTION

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Work under separate contracts.
6. Future work.
7. Purchase contracts.
8. Owner-furnished products.
9. Contractor-furnished, Owner-installed products.
10. Access to site.
11. Coordination with occupants.
12. Work restrictions.
13. Specification and drawing conventions.
14. Miscellaneous provisions.

1.3 PROJECT INFORMATION

A. Project Identification: North Jersey District Water Supply Commission Filter Building Boiler Replacement.

1. Project Location: 310 Fairfield Road, Wayne, NJ 07470.

B. Owner: North Jersey District Water Supply Commission, 1 F.A. Orechio Drive, Wanaque, NJ 07465.

1. Owner's Representative: Mr. Chris Clamser

C. Engineer: DLB Associates, 3600 Route 66, Suite 150 - #5981, Neptune, NJ, 732-774-2000.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The design scope of this project will include replacement of the existing HVAC equipment and lighting at the Wanaque South Pump Station Building. The work will be detailed in the following drawing set and accompanying book specifications.

2. The following is a general description of each scope:

a. Mechanical

1) One existing hot water cast iron sectional boiler will be demolished and replaced with two new hot water condensing boilers.

2) A new air separator, expansion tanks, hot water distribution pumps, and piping will be installed and connected to the existing systems.

3) One existing indoor air handler with DX cooling utilizing a ducted indoor condenser and a hot water heating coil will be demolished and replaced with one indoor air handler with DX cooling utilizing an outdoor condensing unit and a hot water heating coil.

4) Two existing exterior rooftop mounted air handlers with hot water heating coils serving the pump room will be demolished and replaced with new units.

5) Ten existing roof mounted exhaust fans will be demolished and replaced with new units.

6) Nine existing hot water unit heaters will be demolished and replaced with new units.

b. Electrical

1) The new equipment will be connected to the existing electrical distribution equipment.

2) New lighting will be installed in the screen room. The screen room lighting will include winches to bring the lighting down to ground level for maintenance.

c. Controls

1) The new equipment will be controlled through onboard controllers.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

C. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways 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 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.

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.

1.6 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage.

Perform the Work so as not to interfere with Owner's day-to-day 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 approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated.

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 providing temporary utility services according to requirements indicated:

1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
2. Obtain Construction Manager's written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Construction Manager not less than two days in advance of proposed disruptive operations.
2. Obtain Construction Manager's written permission before proceeding with disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

F. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

G. Employee Identification: Owner will provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

H. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.8 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. 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.

3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

BECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Division 1 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

2. Divisions 2 through 26 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

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 in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use facsimile of form provided in Project Manual.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
   a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
   b. Coordination 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 substitution 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 and names and addresses of Engineers and owners.
   h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
   i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
   j. Detailed comparison of Contractor's construction schedule using proposed substitution 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.

k. Cost information, including a proposal of change, if any, in the Contract Sum.

l. 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.

m. 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. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer 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 Engineer's Supplemental Instructions for minor changes in the Work.

b. Use product specified if Engineer 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.

PART 2 - PRODUCTS

2.1 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: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer 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: Engineer will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Engineer.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

b. Requested substitution does not require extensive revisions to the Contract Documents.

c. Requested substitution is consistent with the Contract Documents and will produce indicated results.

d. Substitution request is fully documented and properly submitted.

e. Requested substitution will not adversely affect Contractor's construction schedule.

f. Requested substitution has received necessary approvals of authorities having jurisdiction.

g. Requested substitution is compatible with other portions of the Work.

h. Requested substitution has been coordinated with other portions of the Work.

i. Requested substitution provides specified warranty.

j. 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.

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 and Supplementary Conditions and other Division 1 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. Division 1 Section "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on form included in Project Manual.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer 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 Engineer are not instructions either to stop work in progress or to execute the proposed change.

2. Within time specified in Proposal Request 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. Use available total float before requesting an extension of the Contract Time.

e. Quotation Form: Use forms acceptable to Engineer.

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 Engineer.

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 Division 1 Section "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 Engineer.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor on form included in Project Manual.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Engineer may issue a Construction Change Directive on form included in Project Manual. 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 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 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. Requests for Information (RFIs).
4. Project Web site.
5. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Division 1 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 1 Section "Closeout Procedures" for coordinating closeout of the Contract.
4. Division 1 Section "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. RFI: Request from Owner, Engineer, 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, and telephone number 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: Within 15 days of starting construction operations, 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 and telephone numbers, including home, office, and 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. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

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. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with 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 with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. 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. Pre-installation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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 the coordination drawings by multiple contractors 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 Engineerural, structural, civil, 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 the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer 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 and Reflected Ceiling Plans: Show engineering and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices. 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 valves, access doors, cleanouts and electrical distribution equipment.

6. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
   c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
   d. Location of pull boxes and junction boxes, dimensioned from column center lines.
7. Review: Engineer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make changes as directed and resubmit.
8. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 1 Section "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
   2. File Preparation Format: DWG Version, operating in Microsoft Windows operating system.
   3. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format or Portable Data File (PDF) format.
   4. Engineer will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
      a. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

1.7 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.

2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.

2. Project number.

3. Date.

4. Name of Contractor.

5. Name of Engineer.

6. RFI number, numbered sequentially.

7. RFI subject.

8. Specification Section number and title and related paragraphs, as appropriate.

9. Drawing number and detail references, as appropriate.

10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

12. Contractor's signature.

13. 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: Form bound in Project Manual.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven working days for Engineer's response for each RFI. RFIs received by Engineer 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 Engineer's actions on submittals.

g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

3. Engineer'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 Division 1 Section "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within **10** 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 the following:

1. Project name.

2. Name and address of Contractor.

3. Name and address of Engineer.

4. RFI number including RFIs that were returned without action or withdrawn.

5. RFI description.

6. Date the RFI was submitted.

7. Date Engineer's response was received.

F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 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 Engineer of scheduled meeting dates and times.

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 Engineer, 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 Engineer, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.

2. Attendees: Authorized representatives of Owner, Engineer, 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.

3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.

b. Phasing.

c. Critical work sequencing and long-lead items.

d. Designation of key personnel and their duties.

e. Lines of communications.

f. Procedures for processing field decisions and Change Orders.

g. Procedures for RFIs.

h. Procedures for testing and inspecting.

i. Procedures for processing Applications for Payment.

j. Distribution of the Contract Documents.

k. Submittal procedures.

l. Preparation of record documents.

m. Use of the premises and existing building.

n. Work restrictions.

o. Working hours.

p. Owner's occupancy requirements.

q. Responsibility for temporary facilities and controls.

r. Procedures for moisture and mold control.

s. Procedures for disruptions and shutdowns.

t. Construction waste management and recycling.

u. Parking availability.

v. Office, work, and storage areas.

w. Equipment deliveries and priorities.

x. First aid.

y. Security.

z. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Engineer, but no later than 30 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, Engineer, 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 preparing operations and maintenance data.
    e. Requirements for delivery of material samples, attic stock, and spare parts.
    f. Requirements for demonstration and training.
    g. Preparation of Contractor's punch list.
    h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    i. Submittal procedures.
    j. Coordination of separate contracts.
    k. Owner's partial occupancy requirements.
    l. Installation of Owner's furniture, fixtures, and equipment.
    m. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

D. Progress Meetings: Conduct progress meetings at regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, and Engineer, 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) Deliveries.
      6) Off-site fabrication.
      7) Access.
      8) Site utilization.
      9) Temporary facilities and controls.
      10) Progress cleaning.
      11) Quality and work standards.
      12) Status of correction of deficient items.
      13) Field observations.
      14) Status of RFIs.
      15) Status of proposal requests.
      16) Pending changes.
      17) Status of Change Orders.

18) Pending claims and disputes.

19) 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.

E. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.

1. Attendees: In addition to representatives of Owner, and Engineer, 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 utilization.

9) Temporary facilities and controls.

10) Work hours.

11) Hazards and risks.

12) Progress cleaning.

13) Quality and work standards.

14) Change Orders.

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 and Supplementary Conditions and other Division 1 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. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Special reports.

B. Related Requirements:

1. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
2. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

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 the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Engineer.

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 when activities can be performed and the critical path of Project.

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 time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

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 the completion of 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, where indicated.

2. PDF electronic file.

3. Two paper copies.

B. Startup construction schedule.

1. Approval 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 electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

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 all 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 all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.

3. Total Float Report: List of all activities sorted in ascending order of total float.

4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at monthly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of unusual event.

K. 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 Engineer's request.

B. Pre-scheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages, area separations and interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and re-submittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. 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.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed 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.

B. Activities: Treat each story 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 Engineer.

2. Procurement Activities: Include procurement process activities for the following long lead 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.

3. Submittal Review Time: Include review and re-submittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.

4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.

6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. 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 Division 1 Section "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 Division 1 Section "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. Partial occupancy before Substantial Completion.

   e. Use of premises restrictions.

   f. Provisions for future construction.

   g. Seasonal variations.

   h. Environmental control.

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.

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. Structural completion.

b. Temporary enclosure and space conditioning.

c. Permanent space enclosure.

d. Completion of mechanical installation.

e. Completion of electrical installation.

f. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

1. Temporary enclosure and space conditioning.

E. 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 Division 1 Section "Payment Procedures" for cost reporting and payment procedures.

F. 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 Contract Time.

G. Recovery Schedule: When periodic update indicates the Work is 14 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, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Use Microsoft Project or Primavera for Windows XP operating system.

2.2 STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.

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 30 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 14 days of date established for the Notice to Proceed. 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.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice of Award. Outline significant construction activities for the first 90 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 cost- and resource-loaded, 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 30 days after date established for the Notice to Proceed.

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, regardless of Engineer's approval of the schedule.

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 in order 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 commissioning.

j. Punch list and final completion.

k. 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. Sub-networks 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 Engineer'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 Engineer.

   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.

2.5 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. 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.

2.6 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: 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, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.

1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.

2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week 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.

C. Distribution: Distribute copies of approved schedule to Engineer, 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.

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final completion construction photographs.
4. Web-based construction photographic documentation.

B. Related Requirements:

1. Division 1 Section "Submittal Procedures" for submitting photographic documentation.
2. Division 1 Section "Selective Demolition" for photographic documentation before selective demolition operations commence.
3. Division 1 Section "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
4. Division 1 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For photographer.

B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

C. Digital Photographs: Submit image files within three days of taking photographs.

1. Digital Camera: Minimum sensor resolution of 8 megapixels.

2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, un-cropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.

3. Identification: Provide the following information with each image description in file metadata tag:

a. Name of Project.

b. Name and contact information for photographer.

c. Name of Engineer.

d. Name of Contractor.

e. Date photograph was taken.

f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.5 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

B. Digital Video Recordings: Provide high-resolution, digital video disc in format acceptable to Engineer.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in file name for each image.

2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Engineer.

D. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.

1. Flag construction limits before taking construction photographs.

2. Take 20 photographs to show existing conditions before starting the Work.

E. Periodic Construction Photographs: Take 20 photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Engineer-Directed Construction Photographs: From time to time, Engineer will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

G. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Engineer will inform photographer of desired vantage points.

1. Do not include date stamp.

H. Additional Photographs: Engineer may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum or in the allowance for construction photographs.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:
    a. Special events planned at Project site.
    b. Immediate follow-up when on-site events result in construction damage or losses.
    c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
    d. Substantial Completion of a major phase or component of the Work.
    e. Extra record photographs at time of final acceptance.
    f. Owner's request for special publicity photographs.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Division 1 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Division 1 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Division 1 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
5. Division 1 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer'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 Engineer'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."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.

    b. Specification Section number and title.

    c. Submittal category: Action; informational.

    d. Name of subcontractor.

    e. Description of the Work covered.

f. Scheduled date for Engineer's final release or approval.

g. Scheduled date of fabrication.

h. Scheduled dates for purchasing.

i. Scheduled dates for installation.

j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Engineer's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Engineer for Contractor's use in preparing submittals.

1. Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

a. Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD.

c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

d. The following digital data files will by furnished for each appropriate discipline:

1) Floor plans.

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 different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer 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 re-submittals, as follows. Time for review shall commence on Engineer'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 re-submittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer 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. Re-submittal Review: Allow 15 days for review of each re-submittal.

4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.

2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.

3. Include the following information for processing and recording action taken:

    a. Project name.

    b. Date.

    c. Name of Engineer.

    d. Name of Contractor.

e. Name of subcontractor.

f. Name of supplier.

g. Name of manufacturer.

h. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Re-submittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).

i. Number and title of appropriate Specification Section.

j. Drawing number and detail references, as appropriate.

k. Location(s) where product is to be installed, as appropriate.

l. Other necessary identification.

4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will discard submittals received from sources other than Contractor.

a. Transmittal Form for Paper Submittals: Use facsimile of sample form included in Project Manual.

b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:

1) Project name.

2) Date.

3) Destination (To:).

4) Source (From:).

5) Name and address of Engineer.

6) Name of Contractor.

7) Name of firm or entity that prepared submittal.

8) Names of subcontractor, manufacturer, and supplier.

9) Category and type of submittal.

10) Submittal purpose and description.

11) Specification Section number and title.

12) Specification paragraph number or drawing designation and generic name for each of multiple items.

13) Drawing number and detail references, as appropriate.

14) Indication of full or partial submittal.

15) Transmittal number, numbered consecutively.

16) Submittal and transmittal distribution record.

17) Remarks.

18) Signature of transmitter.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file 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.

   a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-06100.01). Re-submittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-06100.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.

4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:

   a. Project name.

   b. Date.

   c. Name and address of Engineer.

   d. Name of Contractor.

e. Name of firm or entity that prepared submittal.

f. Names of subcontractor, manufacturer, and supplier.

g. Category and type of submittal.

h. Submittal purpose and description.

i. Specification Section number and title.

j. Specification paragraph number or drawing designation and generic name for each of multiple items.

k. Drawing number and detail references, as appropriate.

l. Location(s) where product is to be installed, as appropriate.

m. Related physical samples submitted directly.

n. Indication of full or partial submittal.

o. Transmittal number, numbered consecutively.

p. Submittal and transmittal distribution record.

q. Other necessary identification.

r. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

a. Project name.

b. Number and title of appropriate Specification Section.

c. Manufacturer name.

d. Product name.

F. Options: Identify options requiring selection by Engineer.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Re-submittals: Make re-submittals 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 Engineer's action stamp.

I. 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.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

a. Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide 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.

a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable 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 showing 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 or concurrent with Samples.

6. Submit Product Data in the following format:

a. PDF electronic file.

C. 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 Engineer's digital data drawing files is otherwise permitted.

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 (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).

3. Submit Shop Drawings in the following format:

a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.

b. Product name and name of manufacturer.

c. Sample source.

d. Number and title of applicable Specification Section.

e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Engineer will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:
    a. PDF electronic file.
    b. Three paper copies of product schedule or list unless otherwise indicated. Engineer, will return two copies.

F. Coordination Drawing Submittals: Comply with requirements specified in Division 1 Section "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 1 Section "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 1 Section "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Division 1 Section "Operation and Maintenance Data."

L. 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 Engineers and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in

the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

N. 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.

O. 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.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. 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.

S. 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.

T. 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:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

U. 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.

V. 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 primers and substrate preparation needed for adhesion.

W. 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.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 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 Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies 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.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action 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 Engineer.

B. Project Closeout and Maintenance Material Submittals: See requirements in Division 1 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.2 ENGINEER'S ACTION

A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer 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 Engineer.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for re-submittal without review.

E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 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 inspecting 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 -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:

1. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. 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.

B. 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. Services do not include contract enforcement activities performed by Engineer.

C. 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.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. 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, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

I. Experienced: When used with an entity or individual, "experienced" 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.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision 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 Engineer for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Engineer.

2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Engineer.

D. 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.

E. 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.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

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, and telephone number 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 inspecting.
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 re-inspecting.

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, and telephone number 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 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, and telephone number 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 whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, 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.

1.8 QUALITY ASSURANCE

A. General: 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.

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, 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 are 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 for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

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 installation 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:
1. Contractor responsibilities include the following:
a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, 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. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.

3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

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. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these 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 inspecting 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 inspecting 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.

C. 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 Division 1 Section "Submittal Procedures."

D. 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 pre-installation 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.

E. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location 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 any duties of Contractor.

G. Associated Services: Cooperate with agencies 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 inspecting. 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 inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. 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 as the Work progresses.

1. Distribution: Distribute schedule to Owner, Engineer, testing agencies and each party involved in performance of portions of the Work where tests and inspections are required.

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 Engineer.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, 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 Division 1 Section "Execution Requirements."

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

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. NJDWSC: North Jersey District Water Supply Commission, Owner.

B. General: Basic Contract definitions are included in the Conditions of the Contract.

C. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

D. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

E. "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."

F. "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.

G. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

H. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

I. "Provide": Furnish and install, complete and ready for the intended use.

J. "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.

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 Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960

AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Engineerural Manufacturers Association www.aamanet.org	(847) 303-5664
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	American Concrete Institute www.concrete.org	(248) 848-3700
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Engineers (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AMCA	Air Movement and Control Association International, Inc.	(847) 394-0150

	www.amca.org	
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
AWCI	Association of the Wall and Ceiling Industry www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353

AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604

CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA) www.intertek.com	(800) 967-5352
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FMRC	Factory Mutual Research (Now FM Global)	
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
GA	Gypsum Association www.gypsum.org	(202) 289-5440

GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Part of GSI)	
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
IAS	International Approval Services (Now CSA International)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11

	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150
ITS	Intertek Testing Service NA (Now ETL SEMCO)	
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Engineerural Metal Manufacturers www.naamm.org	(630) 942-6591
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NCMA	National Concrete Masonry Association	(703) 713-1900

	www.ncma.org	
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-2300
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
PDI	Plumbing & Drainage Institute	(800) 589-8956

	www.pdionline.org	(978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(866) 817-8888 (703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331

STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) www.windowcoverings.org	(800) 506-4636 (212) 297-2109
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200

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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials	(909) 472-4100

	www.iapmo.org	
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
UBC	Uniform Building Code (See ICC)	

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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(800) 488-3111
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Buildings Service (See GSA)	

PHS	Office of Public Health and Science www.osophs.dhhs.gov/ophs	(202) 690-7694
SD	State Department www.state.gov	(202) 647-4000
USDA	Department of Agriculture www.usda.gov	(202) 720-2791

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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Engineerural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 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. Division 1 Section "Substitution Procedures" for requests for substitutions.

2. Division 1 Section "References" for applicable industry standards for products specified.

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. Products salvaged or recycled from other projects are not considered new products.

3. Comparable Product: Product that is demonstrated and approved through submittal process 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 specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.

2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Division 1 Section "Submittal Procedures."

b. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures". Show compliance with requirements.

1.5 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. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

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 to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weather-tight enclosure above ground, with ventilation adequate to prevent condensation.

4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
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.
7. 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 warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for 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 with the Specifications, prepare a written document using indicated form properly executed.

C. Submittal Time: Comply with requirements in Division 1 Section "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 not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer 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 "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. 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.
2. 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.
3. Products:
    a. Restricted List: 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 be considered unless otherwise indicated.
    b. Non-restricted List: 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.

Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

   a. Restricted List: 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.

   b. Non-restricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. 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 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.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

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 Engineers and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 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. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Requirements:

1. Division 1 Section "Summary" for limits on use of Project site.
2. Division 1 Section "Submittal Procedures" for submitting surveys.
3. Division 1 Section "Selective Demolition" for demolition and removal of selected portions of the building.
4. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.

2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.

3. Products: List products to be used for patching and firms or entities that will perform patching work.

4. Dates: Indicate when cutting and patching will be performed.

5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

A. 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, notify Engineer of locations and details of cutting and await directions from Engineer 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. Mechanical systems piping and ducts.

f. Control systems.

g. Communication systems.

h. Fire-detection and -alarm systems.

i. Conveying systems.

j. Electrical wiring systems.

k. Operating systems of special construction.

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. Exterior curtain-wall construction.

d. Sprayed fire-resistive material.

e. Equipment supports.

f. Piping, ductwork, vessels, and equipment.

g. 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 Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

B. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: 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 requirements in Division 1 sustainable design requirements Section.

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 Engineer for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.

B. 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.

2. List of detrimental conditions, including substrates.

3. List of unacceptable installation tolerances.

4. Recommended corrections.

C. 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 caused by differing field conditions outside the control of Contractor, submit a request for information to Engineer according to requirements in Division 1 Section "Project Management and Coordination."

D. Surface and Substrate Preparation: Comply with manufacturer's written recommendations for preparation of substrates to receive subsequent work.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.

B. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

3.4 INSTALLATION

A. General: 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 (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

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 the best possible results. 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.

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: Do not use tools or equipment that produce harmful 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 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.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.

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. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

A. Cutting and Patching, 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 according to requirements in Division 1 Section "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 Division 2 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. 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 minimize 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. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or re-hang 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 weather-tight 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.

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

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. Pre-installation Conferences: Include Owner's construction personnel at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. General: 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 (27 deg C).

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 in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. 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.

H. 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.

I. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 1 Section "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Division 1 Section "Quality Requirements."

3.9 PROTECTION 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. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01700

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 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.
5. Repair of the Work.

B. Related Requirements:

1. Division 1 Section "Photographic Documentation" for submitting final completion construction photographic documentation.
2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
3. Division 1 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
5. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
6. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 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 1 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

3. Submit closeout submittals specified in individual Divisions 2 through 16 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Submit maintenance material submittals specified in individual Divisions 2 through 16 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number where applicable.

   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 Engineer's signature for receipt of submittals.

5. Submit test/adjust/balance records.

6. Submit sustainable design submittals required in Division 1 sustainable design requirements Section and in individual Division 2 through 16 Sections.

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. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

3. Complete startup and testing of systems and equipment.

4. Perform preventive maintenance on equipment used prior to Substantial Completion.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 1 Section "Demonstration and Training."

6. Advise Owner of changeover in heat and other utilities.

7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.

8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

9. Complete final cleaning requirements, including touchup painting.

10. Touch up 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, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer 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 Engineer, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection 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.

1.7 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 according to Division 1 Section "Payment Procedures."

2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. 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.

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, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer 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. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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.
2. Organize items applying to each space by major element, including categories for ceiling, 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 Engineer.
    d. Name of Contractor.
    e. Page number.
4. Submit list of incomplete items in the following format:
    a. MS Excel electronic file. Engineer will return annotated file.
    b. PDF electronic file. Engineer will return annotated file.
    c. Three paper copies. Engineer will return two copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where

commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

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 (215-by-280-mm) 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.

4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. 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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

d. Remove tools, construction equipment, machinery, and surplus material from Project site.

e. 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.

f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

g. Sweep concrete floors broom clean in unoccupied spaces.

h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to

manufacturer's recommendations if visible soil or stains remain.

i. 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.

j. Remove labels that are not permanent.

k. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

p. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Division 1 Section "Temporary Facilities and Controls." Prepare written report.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements.

Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

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 and Supplementary Conditions and other Division 1 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.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. Related Requirements:

1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 1 Section "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
3. Divisions 2 through 26 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

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. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.

b. Enable inserted reviewer comments on draft submittals.

2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Engineer 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. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.

2. List of systems.

3. List of equipment.

4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. 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.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

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."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: 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 Construction Manager.
7. Name and contact information for Engineer.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
10. 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. 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: Enable bookmarking of 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.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) 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, and indicate Specification Section number on bottom of spine. 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.

4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) 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.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. 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.

C. 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.

D. 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.

2.4 OPERATION MANUALS

A. 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.

B. 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.

C. 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.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. 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.

B. 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.

C. 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.

D. 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.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. 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.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. 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 warranty and bond information, as described below.

B. 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.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.

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.

D. 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.

E. 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.

F. 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.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. 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 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. 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.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

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.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.

1. 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.

F. 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 operation and maintenance manuals.

2. Comply with requirements of newly prepared record Drawings in Division 1 Section "Project Record Documents."

G. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

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 and Supplementary Conditions and other Division 1 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 Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Division 1 Section "Execution Requirements" for final property survey.
2. Division 1 Section "Closeout Procedures" for general closeout procedures.
3. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
4. Divisions 2 through 26 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.

2) Submit PDF electronic files of scanned record prints and one of file prints.

3) Submit record digital data files and one set(s) of plots.

4) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit three paper-copy set(s) of marked-up record prints.

2) Submit PDF electronic files of scanned record prints and three set(s) of prints.

3) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy and 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.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 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 archive 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 below first floor.
   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 Engineer'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 sets 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 Engineer. 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 the original Contract Drawings.
2. Format: DWG Version, Microsoft Windows operating system.
3. Format: Annotated PDF electronic file with comment function enabled.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to Engineer for resolution.
6. Engineer will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
   a. See Division 1 Section "Submittal Procedures" for requirements related to use of Engineer's digital data files.
   b. Engineer will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Engineer determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Engineer for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction.

Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Format: Annotated PDF electronic file with comment function enabled.

3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.

4. Identification: As follows:

a. Project name.

b. Date.

c. Designation "PROJECT RECORD DRAWINGS."

d. Name of Engineer.

e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.

4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.

5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. 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, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as 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.

2.4 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 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.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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. Maintenance of Record Documents and Samples: Store record documents and Samples 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 Engineer's reference during normal working hours.

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 and Supplementary Conditions and other Division 1 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. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

B. Related Requirements:

1. Divisions 2 through 16 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For instructor videographer.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.

b. Name and address of videographer.

c. Name of Engineer.

d. Name of Construction Manager.

e. Name of Contractor.

f. Date of video recording.

2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.

3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

4. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals & in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

C. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 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 has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.1 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. Operations manuals.

c. Maintenance manuals.

d. Project record documents.

e. Identification systems.

f. Warranties and bonds.

g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.

b. Instructions on stopping.

c. Shutdown instructions for each type of emergency.

d. Operating instructions for conditions outside of normal operating limits.

e. Sequences for electric or electronic systems.

f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.

b. Equipment or system break-in procedures.

c. Routine and normal operating instructions.

d. Regulation and control procedures.

e. Control sequences.

f. Safety procedures.

g. Instructions on stopping.

h. Normal shutdown instructions.

i. Operating procedures for emergencies.

j. Operating procedures for system, subsystem, or equipment failure.

k. Seasonal and weekend operating instructions.

l. Required sequences for electric or electronic systems.

m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.

b. Checking adjustments.

c. Noise and vibration adjustments.

d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.

b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.

b. Types of cleaning agents to be used and methods of cleaning.

c. List of cleaning agents and methods of cleaning detrimental to product.

d. Procedures for routine cleaning

e. Procedures for preventive maintenance.

f. Procedures for routine maintenance.

g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.

b. Repair instructions.

c. Disassembly; component removal, repair, and replacement; and reassembly instructions.

d. Instructions for identifying parts and components.

e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in

coordination with requirements in Division 1 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Engineer 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, through Engineer, 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. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

E. 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.

END OF SECTION 017900

SECTION 033000 - CAST-IN-PLACE CONCRETE

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 specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

B. Cast-in-place concrete includes the following:

1. Equipment pads and bases.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Laboratory test reports for concrete materials and mix design test.

C. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

D. Copies of Material Safety Data Sheets (MSDS) for any adhesives and other hazardous materials.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI-301 “Specifications for Structural Concrete for Buildings”.
2. ACI-304 “Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete”.
3. ACI-311 “Recommended Practice for Concrete Inspection”.
4. ACI-315 “Details and Detailing for Reinforced Concrete Structures”.
5. ACI-318 “Building Code Requirements for Reinforced Concrete”.
6. ACI-347 “Recommended Practice for Concrete Formwork”.
7. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.
8. Building Code requirements, which are more stringent than the above.
9. Perform concrete work in compliance with NJSDA Safety Policies and Requirements, local, state and federal governing authorities having jurisdiction including 29 CFR 1926 Subpart Q – Concrete and Masonry Construction.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 “A-C or B-B High Density Overlaid Concrete Form”, Class I.
2. Use plywood complying with U.S. Product Standard PS-1 “B-B (Concrete Form) Plywood” Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCS) that will not bond with, stain, or adversely

affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.

1. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

2.2 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or ASTM C1157, Type LH or GU.

1. Use one brand of cement throughout Project unless otherwise acceptable to Architect.

2. Do not re-use cement which has partially set or hardened.

B. Fly Ash:

1. Permitted in drilled piers, footings, pier caps, pile caps, columns, walls, grade beams only.

2. ASTM C 618, Class C or F, except maximum loss on ignition: 6%. Maximum percent retained on #325 sieve: 28%. Maximum water requirement, stated as percentage of control: 100%.

3. Testing: ASTM C311.

4. Percentage of fly ash in mix design shall be by weight, not by volume. Water/cement ratio will be calculated as water/cementitious (total cement and fly ash) ratio.

5. Prohibited: Fly ash in same mix with Type IP blended cement.

6. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.

7. The total fly ash contained in concrete should not be more than 20% of total cementitious materials by weight

8. Submit all fly ash concrete mix designs per ACI 301.

C. Ground Granulated Blast-Furnace Slag (GG BFS):

1. ASTM C 989, Grade 100 or higher.

2. Percentage of GGBF slag in mix design shall be by weight, not by volume. Water-cement ratio shall be calculated as water-cementitious (total Portland cement + GGBF slag) ratio.

3. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.

4. Total fly ash and slag contained in concrete should not be more than 30% of total cementitious materials by weight.

5. Submit all GGBF slag concrete mix designs per ACI 301.

D. Aggregates:

1. Normal weight aggregates: Aggregates shall be crushed stone or gravel complying with ASTM C 33, uniform throughout the work, with fineness modulus not varying by more than 0.15 either way from approved samples; maximum size of coarse aggregate particles shall be ½ inch for slabs on grade and 1” for other concrete. Use in all foundations, slabs on grade, walls, steps, pits, mats, etc.

2. Fine aggregates: Natural sand conforming to ASTM C33.

3. Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18% for large top size aggregates (1½ in.) or 8% - 22% for smaller top size aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100.

E. Water: Potable.

2.3 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.

3.2 MISCELLANEOUS CONCRETE ITEMS

A. Equipment Bases: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

END OF SECTION 033000

SECTION 220001 - CONSTRUCTION ADMINISTRATION FOR PLUMBING WORK

PART 1 - GENERAL

1.01 GENERAL

A. This Section contains requirements for Construction Administration of Plumbing work. These requirements are in addition to any requirements listed elsewhere in the Contract Documents. Where conflicts exist between this section and other sections, the more stringent requirement shall apply.

1.02 REQUESTS FOR INFORMATION

A. Requests For Information (RFI) are questions posed by the Contractor intended to resolve vagueness and conflicts during construction.

B. To submit a RFI, the Contractor must fill out the Request For Information form found in Appendix A of this specification section. Only RFI written on this enclosed form will be acknowledged.

C. Prior to submitting a RFI, the Contractor must thoroughly review the Construction Documents and Specifications and forward the RFI only if the issue in question cannot be resolved. If a RFI questions a clearly noted item or standard construction method which should be known by the Contractor, the Engineer may back charge the Contractor for time spent responding to the RFI.

1.03 SCHEDULE OF VALUES

A. Prior to initiating any work, the Contractor shall submit a Schedule of Values on an AIA G-703 Continuation Sheet outlining Material and Labor costs for each item.

B. Include in the Schedule of Values a line item for resolving Punchlist issues equal to 5% of the total contract value.

C. No Payment Applications will be processed until the Schedule of Values form has been approved by the Engineer.

1.04 EQUIPMENT MANUFACTURER LIST

A. Within ten (10) business days of the contract award date, the Contractor shall submit a list of equipment manufacturers, for the engineer's review and approval that he intends to use on this project.

1.05 SHOP DRAWING SUBMISSION SCHEDULE

A. Prior to submitting any Shop Drawings, the Contractor shall issue a Shop Drawing Submission Schedule. The purpose of this schedule is to identify which items require Shop Drawings and when these Shop Drawings will be submitted to the Engineer. By agreeing to this schedule at the beginning of the project, Shop Drawings will be reviewed in a timely fashion and long lead items can be prioritized and reviewed first.

B. Refer to the Shop Drawing Submission Schedule in Appendix A of this specification section. The Contractor shall list all the items that require submittals per the Contract Documents and Specifications. The Contractor shall fill out the Submittal Date column for each item and return the completed form to the Engineer for review. The Contractor may use a different form of his choosing provided the required information is provided.

C. No Shop Drawings will be reviewed until the Shop Drawing Submission Schedule is approved by the Engineer.

1.06 SHOP DRAWINGS

A. Shop Drawings will not be reviewed until the Equipment Manufacturer List and Shop Drawing Submission Schedule have been submitted to, and approved by, the Engineer.

B. Shop Drawings must include a completed copy of the Shop Drawing Submittal Form found in Appendix A of this specification section.

1. The Contractor must review and stamp all Shop Drawings prior to submission. Space has been provided for the Contractor's stamp on the Shop Drawing Submittal Form. Submittals without the Contractor's stamp will be returned unchecked.

C. The Contractor shall provide a maximum of six (6) copies of submittals to the Engineer for review. Additional Shop Drawings may be marked-up and processed for an additional fee to the Contractor.
1. Submitted items shall be clearly identified on all copies of the Shop Drawings. The Engineer will return any Shop Drawings that are not clearly marked.

D. It is the responsibility of the Contractor to make every attempt to ensure thoroughness and accuracy of his submittals. If Shop Drawings are not approved following a maximum of two (2) reviews, the Contractor will be backcharged for the Engineer's effort.

1.07 SUBSTITUTIONS

A. Substitutions for specified equipment must include a detailed comparison checklist identifying all pertinent similarities and differences between the two items. Substituted items without a comparison checklist will not be considered.
1. Where substituted items affect other trades, this Contractor is responsible for adjusting the installation as required to accommodate the substitution. This includes, but is not limited to, changes in Architectural, Structural, Plumbing, Mechanical, Plumbing and Fire Protection Systems. This Contractor will pay for all associated costs.

B. Incomplete submittals will be returned rejected.

1.08 SERVICE INTERRUPTION SCHEDULE

A. Within ten (10) business days of the contract award date, the Contractor shall submit a Schedule of Shutdowns of equipment and/or systems for Owner and Engineer review.

B. The Contractor shall notify the Owner and Engineer in writing at least five (5) business days prior to each equipment and/or system shutdown.

1.09 SUBSTANTIAL COMPLETION LETTER

A. The purpose of this letter is to inform the Engineer that the Contractor has reached Substantial Completion.

B. Upon Substantial Completion, the Contractor shall copy the Substantial Completion Letter onto company letterhead, complete the letter and send it to the Engineer. Refer to Appendix A of this specification for this letter.

C. This letter shall be received at the Engineer's office no later than four (4) weeks before the project completion date. Upon receiving the letter, the Engineer will perform a Punch List. The Contractor shall have two (2) weeks to complete the Punch List items upon receiving the Punch List.

1.010 PUNCHLIST COMPLETION LETTER

A. The purpose of this letter is to inform the Engineer that the Contractor has completed all Punchlist items. The Contractor must ensure that all Punchlist items are indeed complete prior to submitting this letter.

B. Upon Punchlist Completion, the Contractor shall copy the Punchlist Completion Letter onto company letterhead, complete the letter and send it to the Engineer. Refer to Appendix A of this specification for this letter.

C. This letter shall be received at the Engineer's office no later than One (1) week before the project completion date. Upon receiving this letter, the Engineer will perform a final walkthrough.

D. Should the Engineer discover during the final walkthrough that all of the Punchlist items have not been completed, the time and expenses associated with a return visit by the Engineer shall be chargeable to the Contractor.

PART 2 - PRODUCTS - Not Used.

PART 3 - EXECUTION - Not Used.

END OF SECTION 220001

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Stack-sleeve fittings.
   3. Sleeve-seal systems.
   4. Sleeve-seal fittings.
   5. Grout.

B. ACTION SUBMITTALS
   1. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.02 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Smith, Jay R. Mfg. Co.
   2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with setscrews.

2.03 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Stainless steel.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.04 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.05 GROUT

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

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.02 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
   3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.03 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.04 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.02 SUMMARY

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

1.03 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

2.02 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brasstype with polished, chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
      g. Retain one of first two subparagraphs below.
      h. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
   2. Escutcheons for Existing Piping:
      a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
      b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.

f. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.

g. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.02 FIELD QUALITY CONTROL

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

END OF SECTION 220518

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Fastener systems.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.03 **PERFORMANCE REQUIREMENTS**

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment.

1.04 **ACTION SUBMITTALS**

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

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
   1. Trapeze pipe hangers.
   2. Pipe stands.
   3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of trapeze hangers.
   2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.06 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.04 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

2.05 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.06 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Trapeze pipe hanger in first paragraph below requires calculating and detailing at each use.

Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Install hangers and supports to allow controlled thermal and seismic 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.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

J. Insulated Piping:
1. Attach clamps and spacers to piping.
a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
3. Shield Dimensions for Pipe: Not less than the following:
a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
4. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.04 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.05 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30

I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Stencils.
   5. Valve tags.
   6. Warning tags.

1.03 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.04 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.02 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
   1. Stencil Material: Aluminum.

2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.03 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

2.04 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.04 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      a. Cold Water: 2 inches, square.
      b. Hot Water: 2 inches, square.
   2. Valve-Tag Color:
      a. Cold Water: Natural
      b. Hot Water: Natural.
   3. Letter Color:
      a. Cold Water: Black
      b. Hot Water: Black

3.05 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.02 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at pipe expansion joints for each type of insulation.
   3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   4. Detail removable insulation at piping specialties, equipment connections, and access panels.
   5. Detail application of field-applied jackets.
   6. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
   1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
   2. Jacket Materials for Pipe: 12 inches long by NPS 2.
   3. Sheet Jacket Materials: 12 inches square.
   4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. When fire-performance characteristics are important requirements, verify surface-burning characteristics of insulation materials by an independent testing agency and require test report submittals.

C. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General" articles for where insulating materials shall be applied.

B. See "Product Characteristics" Article in Evaluations for comparisons and temperature ranges for insulation material properties.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. 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.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Pittsburgh Corning Corporation; Foamglas.
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. If retaining both types of insulation in first two subparagraphs below, indicate where each type applies in insulation system schedules.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Product attributes in first paragraph below are based on Foster Brand products; there are variations among manufacturers.

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
1. Products: Subject to compliance with requirements, provide available products that may be incorporated into the Work include, but are not limited to, the following:
a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.04 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Although other thicknesses for PVC jackets are available, a flame-spread index of 25 and a smoke-developed index of 50 apply only to thicknesses of 30 mils (0.8 mm) and less.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. PVC jackets are available in several colors. Colored jackets may be used to replace field painting. UV rays fade colors in exterior applications. Some colors (black, gray, and white) do not fade as quickly as other colors (red, orange, and green). Colored jackets have different emissivity and are not recommended for outdoor use.
4. Color: White
5. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.05 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ABI, Ideal Tape Division; 491 AWF FSK.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      c. Compac Corporation; 110 and 111.
      d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ABI, Ideal Tape Division; 370 White PVC tape.
      b. Compac Corporation; 130.
      c. Venture Tape; 1506 CW NS.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   4. Adhesion: 64 ounces force/inch in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

2.06 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
   3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

2.07 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Engineered Brass Company.
      b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
      c. McGuire Manufacturing.
      d. Plumberex.
      e. Truebro; a brand of IPS Corporation.
      f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Truebro; a brand of IPS Corporation.
      b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
   2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Where pipe expansion is anticipated, detail expansion compensation for insulation on Drawings and indicate intervals for its occurrence. See the Midwest Insulation Contractors Association's "National Commercial & Industrial Insulation Standards," Plate No. 41A.

C. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

E. Coordinate paragraph below with Drawings.

F. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to

flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.06 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.07 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.08 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Underground piping.
   2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.010 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
   1. NPS 1 and Smaller: Insulation shall be the following:
      a. Cellular Glass: 1-1/2 inches thick.
   2. NPS 1-1/4 and Larger: Insulation shall be the following:
      a. Cellular Glass: 1-1/2 inches thick.

B. Domestic Hot Water:
   1. NPS 1-1/4 and Smaller: Insulation shall be the following:
      a. Cellular Glass: 1-1/2 inches thick.
   2. NPS 1-1/2 Larger: Insulation shall be the following:
      a. Cellular Glass: 1-1/2 inches thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Aboveground interior domestic water pipes, tubes, and fittings inside buildings.

1.03 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.04 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.05 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Tube in "Soft Copper Tube" Paragraph below is available in NPS 1/8 to NPS 12.

C. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

D. Fittings in "Wrought-Copper, Solder-Joint Fittings" Paragraph below are available in NPS 1/4 to NPS 8.

E. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

F. Flanges in "Bronze Flanges" Paragraph below are available in NPS 1/2 to NPS 12 .

G. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

H. Unions in "Copper Unions" Paragraph below are available in NPS 1/4 to NPS 4.

I. Copper Unions:
   1. MSS SP-123.
   2. Cast-copper-alloy, hexagonal-stock body.
   3. Ball-and-socket, metal-to-metal seating surfaces.
   4. Solder-joint or threaded ends.

J. Copper Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Elkhart Products Corporation.
   b. NIBCO Inc.
   c. Viega.
2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
   1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

H. Joints for PEX Piping: Join according to ASTM F 1807.

2.04 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Couplings in "Sleeve-Type Transition Coupling" Paragraph below are available in NPS 1/2 to NPS 144.

D. Sleeve-Type Transition Coupling: AWWA C219.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cascade Waterworks Manufacturing.
      b. Dresser, Inc.; Piping Specialties Products.
      c. Ford Meter Box Company, Inc. (The).
      d. JCM Industries.
      e. Romac Industries, Inc.

E. Plastic-to-Metal Transition Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.
2. Description:
a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

F. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Colonial Engineering, Inc.
b. NIBCO Inc.
c. Spears Manufacturing Company.
2. Description:
a. CPVC four-part union.
b. Brass or stainless-steel threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.05 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Unions in "Dielectric Unions" Paragraph below are available in at least NPS 1/2 to NPS 2.

C. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Jomar International.
e. Matco-Norca.
2. Standard: ASSE 1079.
3. Revise pressure rating and temperature in "Pressure Rating" Subparagraph below to suit Project, or insert other options for specific applications.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous.

D. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Matco-Norca.
d. Watts; a division of Watts Water Technologies, Inc.

e. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Revise pressure rating in "Pressure Rating" Subparagraph below to suit Project, or insert other options for specific applications.
5. Pressure Rating: 125 psig minimum at 180 deg F.
6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

E. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
2. Nonconducting materials for field assembly of companion flanges.
3. Revise pressure rating in "Pressure Rating" Subparagraph below to suit Project, or insert other options for specific applications.
4. Pressure Rating: 150 psig.
5. Gasket: Neoprene or phenolic.
6. Bolt Sleeves: Phenolic or polyethylene.
7. Washers: Phenolic with steel backing washers.

F. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Elster Perfection Corporation.
   b. Grinnell Mechanical Products; Tyco Fire Products LP.
   c. Matco-Norca.
   d. Precision Plumbing Products, Inc.
   e. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Revise pressure rating and temperature in "Pressure Rating and Temperature" Subparagraph below to suit Project, or insert other options for specific applications.
5. Pressure Rating and Temperature: 300 psig at 225 deg F.
6. End Connections: Male threaded or grooved.
7. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install shutoff valve immediately upstream of each dielectric fitting.

C. Install water-pressure-reducing valves downstream from shutoff valves where required. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

D. Install domestic water piping level without pitch and plumb.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

H. Install piping to permit valve servicing.

I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

M. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.02 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

F. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Joint Construction for Solvent-Cemented Plastic Piping: 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. Apply primer.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Piping: Join according to ASTM D 2855.

I. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.03 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.04 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.07 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   2. Piping Tests:
      a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
      b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
      c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
      d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
      e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
      f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.09 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
      a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
      b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.010 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Repeat procedures if biological examination shows contamination.
      e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.011 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
   1. Copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed copper pressure-seal-joint fittings; and pressure-sealed joints.

D. Aboveground domestic water piping, NPS 1-1/4-inch and smaller, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L wrought copper, solder-joint fittings; and soldered joints.

E. Aboveground domestic water piping, NPS 1-1/2 to NPS 4, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L cast- or wrought-copper, solder-joint fittings; and soldered joints.

3.012 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball valves for piping NPS 2-1/2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 3 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2-1/2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 3 and larger.
   3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Vacuum breakers.
   2. Backflow preventers.
   3. Water pressure-reducing valves.
   4. Balancing valves.
   5. Temperature-actuated, water mixing valves.
   6. Strainers.
   7. Drain valves.
   8. Specialty valves.
   9. Flexible connectors.

B. Related Requirements:
   1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers in domestic water piping.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.
   1. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

2.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
      b. Conbraco Industries, Inc.
      c. FEBCO; a division of Watts Water Technologies, Inc.
   2. Standard: ASSE 1001.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Pressure Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
   b. Conbraco Industries, Inc.
   c. FEBCO; a division of Watts Water Technologies, Inc.
   d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Accessories:
   a. Valves: Ball type, on inlet and outlet.

2.04 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.
   b. FEBCO; a division of Watts Water Technologies, Inc.
   c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

2.05 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.

B. Water-Control Valves
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CLA-VAL.
   b. Watts; a division of Watts Water Technologies, Inc.; Control Valves (Watts ACV).

c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
   a. Pattern: Angle, Globe-valve design.
   b. Trim: Stainless steel.
5. Design Flow: Per system demand.
6. Design Inlet Pressure: 80 psig (inlet - minimum).
7. Design Outlet Pressure Setting: 50 PSI (minimum).
8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.06 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armstrong International, Inc.
   b. ITT Corporation; Bell & Gossett Div.
   c. NIBCO Inc.
   d. TACO Incorporated.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.07 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices
1. 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:
   a. Conbraco Industries, Inc.
   b. Honeywell International Inc.
   c. Leonard Valve Company.
   d. Powers; a division of Watts Water Technologies, Inc.
   e. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 105 deg F (or as indicated on Plans).
9. Tempered-Water Design Flow Rate: Per system demand.
10. Valve Finish: Rough bronze.

2.08 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.

2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.020 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
6. Drain: Pipe plug.

2.09 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.010 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Metraflex, Inc.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve.

G. CONNECTIONS

H. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

I. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.02 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Pressure vacuum breakers.
   2. Reduced-pressure-principle backflow preventers.
   3. Double-check, detector-assembly backflow preventers.
   4. Water pressure-reducing valves.
   5. Calibrated balancing valves.
   6. Primary, thermostatic, water mixing valves.
   7. Primary water tempering valves.
   8. Outlet boxes.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.03 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.04 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Liquid-in-glass thermometers.
   2. Thermowells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   1. Standard: ASME B40.200.
   2. Case: Cast aluminum 7-inch (178-mm) nominal size unless otherwise indicated.
   3. Case Form: Adjustable angle unless otherwise indicated.
   4. Tube: Glass with magnifying lens and red organic liquid.
   5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F
   6. Window: Glass
   7. Stem: Aluminum and of length to suit installation.

      a. Design for Thermowell Installation: Bare stem.

8. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1 (DN 15, DN 20, or NPS 25), ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
   1. Metal case, industrial-style, liquid-in-glass type.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F

END OF SECTION 220519

SECTION 230001- CONSTRUCTION ADMINISTRATION FOR HVAC WORK

PART 1 - GENERAL

1.1 GENERAL

A. This Section contains requirements for Construction Administration of Mechanical / HVAC work. These requirements are in addition to any requirements listed elsewhere in the Contract Documents. Where conflicts exist between this section and other sections, the more stringent requirement shall apply.

1.2 SECTION INCLUDES

A. Delegated Design

B. Substitution Procedures

C. Payment Procedures
   1. Schedule of Values

D. Project Management and Coordination
   1. Service Interruption Schedule
   2. Coordination Drawings
   3. Requests for Information (RFIs)

E. Submittal Procedures
   1. Submission Schedule
   2. Shop Drawings

F. Project Requirements
   1. Equipment Manufacturer List

G. Project Record Documents
   1. As-Built Drawings

H. Closeout Procedures
   1. Substantial Completion
   2. Punchlist Completion

I. Operations & Maintenance Data
   1. Operation and Maintenance Manuals

J. Electronic Documentation Exchange

1.3 RELATED REQUIREMENTS

A. Section 012500 ”Substitution Procedures” for requests for substitutions.

B. Section 012900 “Payment Procedures” for additional details on schedule of values and applications for payment.

C. Section 013100 ”Project Management and Coordination” for additional details on general project coordination, coordination drawings, and RFIs.

D. Section 013300 “Submittal Procedures” for additional details on submittal process

E. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

F. Section 017700 “Closeout Procedures” for additional details on record documents

G. Section 017823 "Operation and Maintenance Data"

H. Section 017839 “Project Record Documents”

1.4 DELEGATED DESIGN

A. Definition

1. Materials, components, details, fabrications, systems, calculations or assemblies designed by a licensed engineer engaged by an entity other than the project Engineer of Record. Entities can include (but not be limited to), contractors, subcontractors, suppliers, vendors or fabricators.

B. Design Criteria

1. Basis of design, descriptions or related performance criteria for materials, components, details, fabrications, systems, calculations or assemblies shall be as provided in the contract documents.

C. Delivery

1. Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional.

D. Responsibilities

1. The Contractor shall obtain and pay for the services of a Professional Engineer, with at least 10 years of design experience, licensed to practice in the state in which this project is being constructed. This Professional Engineer shall be responsible for design, documentation, review, submittal documents and implementation elements related to the Delegated Design noted in the contract documents. Delegated Design Professional Engineer shall be designated the Engineer of Record for the scopes of work related to the Delegated Design.

1.5 SUBSTITUTION PROCEDURES

A. Definitions

1. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

2. 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.

3. 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

B. Submission

1. Substitution Requests: Use CSI form 1.5C or equivalent form acceptable to Architect or Engineer.

2. Substitutions for specified equipment must include a detailed comparison checklist identifying all pertinent similarities and differences between the items in question.

3. 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. Research reports evidencing compliance with building code in effect for Project, from applicable codes.

j. 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.

k. Cost information, including a proposal of change, if any, in the Contract Sum.

l. 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.

m. 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.

4. Substituted items without a comparison will not be considered.

5. Where substituted items affect other trades, this Contractor is fully responsible for adjusting the installation as required to accommodate the substitution. This includes, but is not limited to, changes in Architectural, Structural, Mechanical, Electrical, Plumbing and Fire Protection Systems. This Contractor will assume and pay for all associated costs and related impacts.

6. Should substitution provided by the Contractor require changes in design which necessitate Professional Services (architecture, engineering, subconsultants, vendors or related providers) the Contractor shall assume and pay for all related Professional Services costs.

7. Incomplete submittals will be returned as Rejected.

C. 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.

B. Substitutions

1. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than **15 working days** prior to time required for preparation and review of related submittals.

a. Conditions: Architect or Engineer 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:

1) Revise conditions in subparagraphs below. If required, insert more restrictive conditions to limit consideration of proposed substitutions.

2) Requested substitution is consistent with the Contract Documents and will produce indicated results.

3) Substitution request is fully documented and properly submitted.

4) Requested substitution will not adversely affect Contractor's construction schedule.

5) Requested substitution has received necessary approvals of authorities having jurisdiction.

6) Requested substitution is compatible with other portions of the Work.

7) Requested substitution has been coordinated with other portions of the Work.

8) Requested substitution provides specified warranty.

9) 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.

2. Substitutions for Convenience: Not allowed unless otherwise indicated.

3. 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. Revise conditions in subparagraphs below. If required, insert more restrictive conditions to limit consideration of proposed substitutions.

b. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

c. Requested substitution does not require extensive revisions to the Contract Documents.

d. Requested substitution is consistent with the Contract Documents and will produce indicated results.

e. Substitution request is fully documented and properly submitted.

f. Requested substitution will not adversely affect Contractor's construction schedule.

g. Requested substitution has received necessary approvals of authorities having jurisdiction.

h. Requested substitution is compatible with other portions of the Work.

i. Requested substitution has been coordinated with other portions of the Work.

j. Requested substitution provides specified warranty.

k. 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.

1.6 PAYMENT PROCEDURES

A. Schedule of Values

1. Prior to initiating any work, the Contractor shall submit a Schedule of Values on an AIA G-703 Continuation Sheet outlining Material and Labor costs for each item.

2. Include in the Schedule of Values a line item for resolving Punchlist issues equal to 5% of the total contract value.

3. No Payment Applications will be processed until the Schedule of Values form has been approved by the Engineer.

1.7 PROJECT MANAGEMENT AND COORDINATION

A. Service Interruption Schedule

1. Within ten (10) business days of the contract award date, the Contractor shall submit a Schedule of Shutdowns of equipment and/or systems for Owner and Engineer review.

2. The Contractor shall notify the Owner and Engineer in writing at least five (5) business days prior to each equipment and/or system shutdown.

B. Coordination Drawings

1. Definition:

a. Contractor-prepared drawings submitted by Contractor to Owner to demonstrate: (1) The coordination of methods, materials, equipment, systems, plans, or sequence the Contractor proposes to use for installation of different components within the architectural, structural, civil and environmental envelope; (2) The coordination required for installation of Products and materials Fabricated by separate entities; and (3) The relationship of components shown on separate Shop Drawings or Submittals, when coordination among these components is required.

2. Contract Documents

a. Contract drawings are diagrammatic in nature with respect to mechanical, electrical, plumbing, fire protection, specialty systems (medical/industrial gasses, compressed air, etc.), and related low voltage (life safety and non-life safety) systems. Not every bend, offset and direction change is shown in the Contract Documents. The Contract Documents represent that these systems will fit in the spaces allotted; however, it is the responsibility of the Contractor to assign space priorities, lay out and route the systems so they will fit efficiently in the allotted spaces and allow for convenient and code-conforming access and maintenance space to all valves, dampers, filters, panels and other devices.

b. Layout of utility, HVAC equipment and electrical rooms, is diagrammatic in nature. The Contract Documents represent that equipment identified to be installed in these rooms will fit in the spaces allotted. However, because the Contractor must submit and provide for equipment to be installed in these rooms, it is the Contractor’s responsibility to lay-out the equipment room such that all equipment will fit.

c. The Contractor must examine all the Contract drawings, especially architectural for ceiling space dimensions, and structural for beam/column obstructions, and make allowances in the Contractor’s planned coordination efforts, work sequence, and routing of the systems.

d. Routing shown for pipes, ducts, and conduits on Drawings are shown by graphic symbols only; make runs parallel with lines of building.

e. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

f. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated; coordinate locations of fixtures and outlets with finish elements.

g. Size ductwork, mechanical pipe, plumbing, electrical, and sprinkler system components as shown in the Contract Documents and Drawings. Downsizing of Mechanical/Electrical/Plumbing/Fire Protection (M/E/P/FP) systems is not permitted.

3. Coordination Drawing Development

   a. Contractor shall prepare, and submit for acceptance, Coordination Drawings as a submittal/shop drawing prior to equipment or system installation. Contractor shall prepare Coordination Drawings in order to resolve potential installation and constructability problems prior to installation so that construction cost and schedule are not impacted.

   b. Coordination Drawings shall include dates and signatures of the Contractor and all Subcontractors whose work occurs in the space; signed Coordination Drawings shall be subject to examination by the Owner at any time.

   c. Contractor shall require Subcontractors to develop Subcontractor Coordination Plans of the same scale as Contractor's Coordination Drawings to assist in making transcripts for transfer to Coordination Drawings; use approved Shop Drawings for Coordination Drawings.

   d. Contractor shall require Subcontractors to develop Subcontractor Coordination Plans of the same scale as Contractor's Coordination Drawings to assist in making transcripts for transfer to Coordination Drawings; use approved Shop Drawings for Coordination Drawings.

   e. Coordination drawings will be developed, at a minimum, as editable AutoCAD drawings with separate layers for each system or trade. Contractor shall make drawings available for Owner review upon request.

   f. Coordination drawings shall be used as the baseline for development and submission of As-Built drawings by the Contractor.

4. Coordination Drawing Elements To Be Clearly Shown

   a. Layout and routing of mechanical, electrical, plumbing, fire protection and related low voltage (life safety and non-life safety) systems in above-ceiling spaces, utility chases, raised flooring (if applicable), other interstitial spaces, and underground ducts. Elements to include in Coordination Drawings include:

      1) Mechanical ducts and pipes, including floor penetrations;

      2) Plumbing pipes, including supply and gravity drain lines;

      3) Fire protection branch lines and sprinkler heads;

      4) Electrical panels, conduit, bus ducts;

      5) Voice/data cable trays and conduits;

      6) Interstitial space access;

      7) Identification and resolution of interfering structural elements: beams, columns, slabs, hangers, bracing, etc. and mechanical/electrical systems;

      8) Identification and resolution of conflicts with mechanical/electrical systems and fire-rated walls;

      9) Identification and resolution of conflicts between mechanical and electrical systems and suspended ceilings and light fixtures;

      10) Identification and resolution of conflicts between mechanical and electrical systems and insulation;

      11) Security system elements;

12) The relationship of components that are shown on separate Shop Drawings or Submittals.

13) Seismic restraints where required on systems.

14) All Work above ceilings performed by separate entities that must interface or for which space provided is limited; and

15) Others as necessary.

b. Actual physical relationships of the various elements and systems and their interfacing with other elements and systems. The Drawings use graphic symbols to show certain physical relationships. Establishing and coordinating the actual physical relationships is the responsibility of the Contractor. Layout and arrange all elements to contribute to safety and efficiency while maintaining the intent of the design. Before work proceeds in areas of potential conflict for installing different components of the work, Contractor shall prepare Coordination drawings for review and acceptance by the Owner, that clearly demonstrate resolution of any conflicts.

c. Dimensions and elevations where conflicts may exist. Final Coordination drawings shall show resolution of any potential field conflicts.

d. Location, for maintenance and repair purposes, of all above-ceiling valves, fire dampers, control devices, meters and gauges, and heating coils, and the access hatches (in “hard lid) ceilings that provide a means of access to these devices. These devices and appurtenances must be located such that a workman has unimpeded access to perform maintenance, repair or replacement. "Unimpeded access" means that a workman can access the device from a location immediately below the device, via the removal of a lay-in ceiling tile, or an access door/panel. All above-ceiling valves, fire dampers, control devices and heating coils shall be located such that there are no interferences from systems furniture, or above-ceiling mechanical or electrical systems. The Coordination drawings must clearly represent this accessibility.

e. How equipment, controls, valves, power panels and disconnects will fit in ceilings, equipment room(s) space, and still comply with code, and manufacturer’s maintenance requirements, with respect to clearance.

f. Maintenance of fire-rating of so-designated walls. Contractor shall review the architectural drawings for the location of fire-rated walls, and ensure that the placement of ducts, pipes or other systems do not compromise the fire-rating of walls. If ducts do penetrate fire-rated walls, the coordination drawings must show such penetrations, and shall indicate the placement of required Fire-smoke dampers. If the fire rating of designated walls cannot be maintained due to pipe or duct penetrations, as part of the Coordination Drawing process, the Contractor shall immediately bring these situations to the attention of the Owner.

5. Contractor Coordination Drawing Responsibilities

a. Oversee preparation of Coordination Drawings, as required by this Section.

b. Assign space priorities

c. Notify Owner in writing of unresolved conflicts or interferences found during preparation of Coordination Drawings.

C. Requests for Information

1. Requests for Information (RFI) are questions posed by the Contractor intended to resolve vagueness and conflicts during bidding or construction.
2. To submit a RFI, the Contractor must utilize one of the following approaches:
    a. Complete an AIA G716 Request For Information form or equal as approved by Architect or Engineer. Where prior approval by Architect or Engineer has been obtained, RFI may be submitted electronically via email using a common Subject Line format. An electronically submitted RFI must include all information found on AIA form
        1) Subject Line (Example): Project Name – Trade (MEP or FP) RFI #XXXX
        2) All RFI requests must be copied electronically to the architect (where applicable).
    b. Where implemented by Architect or Engineer, RFI may be submitted via web-based project management software platform using pre-defined forms.
3. Independent of the RFI submission format used, all fields must be fully complete and submitted with a proposed solution, response, selection or approach. Incomplete RFIs or those submitted without a proposed solution will be returned unchecked.
4. Where possible, all RFI should be accompanied with pictures, tables, graphs, sketches or supplementary explanatory material. This procedure allows the responder to have as much information as practical at the time of review for timely and accurate responses.
5. Quality Control & Certification
    a. Prior to submitting a RFI, the Contractor must thoroughly review the Construction Documents and Specifications and forward the RFI only if the issue in question cannot be resolved. If an RFI questions a clearly noted item or standard construction method which should be known by the Contractor, the Engineer may back charge the Contractor for time spent responding to the RFI.
    b. Certification Statement: I certify that I have thoroughly reviewed the Documents and am unable to reconcile this issue. I acknowledge that if the issue is easily reconcilable by reviewing the Documents or is asking direction on standard construction methods that should be known by the Contractor, the Professionals can back charge the Requestor for the effort involved in the review and response.

1.8 SUBMITTAL PROCEDURES

A. Submission Schedule

1. Prior to submitting any Shop Drawings, the Contractor shall issue a Shop Drawing Submission Schedule. The purpose of this schedule is to identify which items require Shop Drawings and when these Shop Drawings will be submitted to the Engineer. By agreeing to this schedule at the beginning of the project, Shop Drawings will be reviewed in a timely fashion and long lead items can be prioritized .
2. The Contractor shall list all the items that require submittals per the Contract Documents and Specifications. At a minimum, the submittal schedule must include the following columns associated with each submitted:
    a. Specification Section Reference Number
    b. Specification Section Title

c. Submittal ID Number

d. Product, Material or System Description

e. Schedule Information

1) Submittal Submission Date

2) Anticipated Return Date (best guess)

3) Long Lead Item (Y / N)

4) Expedited Review Required (Y / N)

3. Contractor shall provide complete information for each column heading for each item and return the completed document to the Engineer for review. The Contractor may use spreadsheets or web-based project management software platform provided all required information is provided.

4. No Shop Drawings will be reviewed until the Shop Drawing Submission Schedule is approved by the Engineer.

B. Shop Drawings

1. Shop Drawings will not be reviewed until the Equipment Manufacturer List and Shop Drawing Submission Schedule have been submitted to, and approved by, the Engineer.

2. Engineer shall review and return submittals within ten (10) business days of receipt. Expedited review of submittals may occur, however such review must be approved by the Engineer prior submission and be noted in the Shop Drawing Submission Schedule. Note that Contractor may only identify a limited number of submittals as requiring Expedite Review.

3. Shop Drawings must include a completed copy of the Shop Drawing Transmittal

a. Contractor must review and stamp all Shop Drawings prior to submission. Stamp shall appear on each contractor transmittal for individual shop drawings. Submittals without the Contractor's stamp will be returned unchecked.

b. Contractor stamp must include a general affidavit of the following:

1) Contractor “X” has reviewed the shop drawings, product data, samples and other submittals that related to this submission. All dimension, quantities, field dimensions existing work interface with other trades and conditions have been verified. These submittals are approved to the extent approval is required by the Contract Documents.

4. Contractor shall submit PDF version of submittal, with transmittal / cover sheet, to the Engineer for review.

a. Submitted items shall be clearly identified on all copies of the Shop Drawings. The Engineer will return any Shop Drawings that are not clearly marked.

5. It is the responsibility of the Contractor to make every attempt to ensure thoroughness and accuracy of his submittals. If Shop Drawings are not approved following a maximum of two (2) reviews, the Contractor will be back-charged for the Engineer's effort.

6. Submittals shall be segregated as individual elements to for timely review and to ensure rejection of one item does not unduly delay other items within the same submittal. Submittals encompassing both equipment and materials (e.g.: pumps and piping) will be returned to the Contractor unchecked.

1.9 PRODUCT REQUIREMENTS

A. Equipment Manufacturer List

1. Within ten (10) business days of the contract award date, the Contractor shall submit a list of equipment manufacturers, for the engineer's review and approval, that he intends to use on this project.

1.10 PROJECT RECORD DOCUMENTS

A. As-Built drawings

1. Contractor to maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings onsite. Review As-built Drawings and shop drawings monthly with the Owner, for approval.

a. Preparation: Daily mark As-built Drawings 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 As-built Drawings.

1) Document with specificity concealed elements that would be difficult to identify or measure and record later.

2) Accurately record information in an acceptable drawing technique.

3) Record data as soon as possible after obtaining it.

4) Record and check the markup before enclosing concealed installations.

b. Content: Types of items requiring marking include, but are not limited to, the following:

1) Dimensional changes to drawings.

2) Revisions to details shown on drawings.

3) Depths of foundations below first floor.

4) Locations, routing and depths (invert elevations) of underground utilities.

5) Revisions to routing of piping and conduits.

6) Revisions to electrical circuitry and lighting.

7) Revisions to low voltage systems (both life safety and non-life safety).

8) Actual equipment locations.

9) Duct and piping sizes and routing.

10) Locations of concealed internal utilities.

11) Changes made by Change Order or Change Directive.

12) Changes made following the Owner’s written orders.

13) Details not on the original Contract Drawings.

14) Field records for variable and concealed conditions.

15) Record information on the Work that is shown only schematically.

c. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up as-built prints.

d. Mark as-built sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

e. Mark important additional information that was either shown schematically or omitted from original drawings.

f. Mark all changes requested by Owner, Architect or Engineer.

g. Note Construction Change Directive numbers, Alternate numbers, Change Order numbers, and similar identification, where applicable.

2. Deliverable

a. As-built drawings will be separated by trade in a manner consistent with the Contract Documents.

b. As-built documents shall be available for review by Owner, Architect or Engineer at the end of each week.

1.11 CLOSEOUT PROCEDURES

A. Substantial Completion

1. The purpose of this document is to inform the Architect or Engineer that the Contractor has reached Substantial Completion.

2. Contractor shall complete AIA G704 or equal as approved by Architect or Engineer. Additionally, a letter on company letterhead shall attesting to the following:

a. Be advised that [Contractor Name] has reached Substantial Completion for the above-mentioned project. We understand that DLB Associates should receive this letter at least four (4) weeks prior to the project completion date. We are prepared for the Punchlist review and assure that any items found to be incomplete will be fixed within two (2) weeks of receiving the Punchlist.

3. The AIA document and letter shall be received at the Architect’s or Engineer's office no later than four (4) weeks before the project completion date. Upon receiving the letter, the Engineer will perform a Punch List. The Contractor shall have two (2) weeks to complete the Punch List items upon receiving the Punch List.

B. Punchlist Completion

1. The purpose of this letter is to inform the Architect or Engineer that the Contractor has completed all Punchlist items. The Contractor must ensure that all Punchlist items are indeed complete prior to submitting this letter.

2. Upon Punchlist Completion, the Contractor shall copy the Punchlist Completion Letter onto company letterhead, complete the letter and send it to the Architect or Engineer. Additionally, a letter on company letterhead shall attesting to the following:

a. Be advised that we have completed all Punchlist items for the above-mentioned project and consider the construction to be 100% complete. We understand that DLB Associates should receive this letter at least one (1) week prior to the project completion date. We are prepared for the final walk through and review.

3. This letter shall be received at the Engineer's office no later than One (1) week before the project completion date. Upon receiving this letter, the Engineer will perform a final walkthrough. Should the Engineer discover during the final walkthrough that not all Punchlist items have not been completed, the time and expenses associated with a return visit by the Engineer shall be chargeable to the Contractor.

1.12 OPERATION AND MAINTENANCE DATA

A. Operation and Maintenance Manuals

1. Furnish three copies of complete operations and maintenance manuals to the architect-engineer for approval prior to delivery to the owner, on all equipment and systems.
   a. Manuals shall be printed on 8-1/2" x 11" paper and bound in three ring binders with clear covers.
   b. Electronic Copies May Be Submitted In Place Of Physical Submissions If Permission Is Granted By Architect And Engineer.
2. The following shall be included:
   a. Title sheet with job name, and the names, addresses and phone numbers of the contractor, subcontractor, control subcontractor, related contractors, material and equipment suppliers. the equipment model numbers and serial numbers shall be listed.
   b. A comprehensive table of contents for all sections.
   c. Printed operating instructions for the owner's personnel describing how to operate (start, stop, and perform normal and emergency operating procedures) each piece of equipment, how to set the temperature control system for normal operation and normal restarting procedures, and caution / warning notices.
   d. A copy of acknowledgment of instruction to the owner's operating personnel in the operation of all equipment and systems, signed by the owner or his authorized representative.
   e. Approved shop drawings, product data, and parts and maintenance booklet for each item of material and equipment furnished under this contract.
   f. Test and balance reports.
   g. Copies of certificates of inspection and warranties, including extended warranties (where applicable).
3. Deliver the manuals to the owner prior to submitting application for final payment.

1.13 PROJECT RECORD DOCUMENTS

A. Record Drawings

1. The contractor shall prepare a complete set of record drawings of all systems including electrical and control diagrams prior to final payment. Final payment shall not be made until the record drawings are deemed complete for all trades and approved by the Engineer.
2. The drawings shall be drafted by a professional draftsman using AutoCAD (DWG format) with discreet file and layer as described in the AIA CAD Layer Guidelines or similar

convention. Other software or layer naming conventions will be approved only in writing by owner and architect/engineer.

3. Record drawings shall clearly indicate the installed conditions of the MEP/FP work as noted in the As-Built drawings for all trades. Contractor shall provide owner with:

   a. Digital storage media containing editable, vector-based, electronic AutoCAD files with required blocks, XREFs, linetypes and styles.

   b. One (1) full size and two (2) half size prints, bound.

   c. PDF of above listed items on digital storage media for owner records.

4. Upon completion and acceptance of work, contractor shall furnish type-written updated panel schedules for any panel in which work was done. Provide a hard copy and electronic copy to the owner.

1.14 ELECTRONIC DOCUMENTATION EXCHANGE

A. Request for Computer Generated Design Documentation

1. Upon written request using the following form and subject to the approval of the Owner, DLB will furnish contractor with computer generated (AutoCAD or BIM/Revit) design document data subject to the qualifications and limitations identified on the request form.

Attn: Name (email)
(DLB Project Manager/Construction Manager Name)

DLB Associates Consulting Engineers, P.C.
3600 Route 66, Suite 150 - #5981, Neptune, NJ 07753
(732) 774-2000
Re: Electronic Document Exchange Agreement

Name
(Project Name)
Address
(Project Address)
######
(DLB Project Number)

Computer generated (AutoCAD or BIM/Revit) design document data is provided at the request of, and for the convenience of the Recipient only. Data has been prepared as a DLB Associates (DLB) internal working document and as such, may be incomplete or contain unintentional accuracies. Additionally, subsequent revisions to actual infrastructure locations after these documents were created may not be reflected in the data files. DLB makes no warranties, either express or implied, as to the accuracy of the data provided. The user is warned that while all digital data appears to be extremely accurate, this apparent accuracy is an artifact of the techniques used in its creation and should in no way imply actual accuracy. Recipient of this data takes full responsibility for the accuracy and correctness of all measurements, areas, elevations, inventories, and related information extracted from files either manually or with the use of a computer.

DLB employs an automated system of complex files links and customized drawing elements to create contract documents. As a result, DLB is unable to simply copy files for distribution. DLB must edit the individual files to create a format which is compatible for outside users. Without these steps, files would be nearly unusable and ultimately take longer for Recipients to adapt versus starting from scratch.

DLB office policy is to charge for electronic document preparation so the Recipient can make use of the data. Charges are based on currently published hourly labor rates. NOTE: Floor plans will be made available for the Recipient. Specifications, spreadsheets, native engineering calculation files, details, general notes, title blocks, diagrams, risers, etc. will not be provided.

Recipient is advised that any translation of data from one computer system or environment to another can result in the loss of important data. Losses can include but are not limited to portions of text and dimensions, the existence, location or scale of symbols or other graphical elements and the internal structure of the data (including layers, data attributes, styles or line weights.) DLB makes no representation as to usability of the data on any outside system.

Recipient confirms, by acceptance and use of data provided, the above conditions, and agrees to the fullest extent of the law, to indemnify and hold DLB harmless from any damage, liability or cost, including but not limited to reasonable attorney's fees and cost of defense, arising from such use, or from any changes made by these files by anyone other than DLB, or from any reuse from the files and data without the prior written consent of DLB.

_____
(Company Name)

_____
(Authorized Signature)

_____
(Printed Name & Date)

PART 2 - PRODUCTS - Not Used.

PART 3 - EXECUTION - Not Used.

END OF SECTION 230001

SECTION 23 01 30.51 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

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 cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

A. ASCS: Air systems cleaning specialist.

B. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For an ASCS.

B. Strategies and procedures plan.

C. Cleanliness verification report.

1.5 QUALITY ASSURANCE

A. ASCS Qualifications: A certified member of NADCA.

1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
2. Supervisor Qualifications: Certified as an ASCS by NADCA.

B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.

B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.

C. Prepare written report listing conditions detrimental to performance of the Work.

D. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:

1. Supervisor contact information.
2. Work schedule including location, times, and impact on occupied areas.
3. Methods and materials planned for each HVAC component type.
4. Required support from other trades.
5. Equipment and material storage requirements.
6. Exhaust equipment setup locations.

B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.

C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3 CLEANING

A. Comply with NADCA ACR 2006.

B. Remove visible surface contaminants and deposits from within the HVAC system.

C. Systems and Components to Be Cleaned:

1. Ductwork:

a. Supply-air ducts, including turning vanes and reheat coils.
b. Return-air ducts to the air-handling unit.

D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.

E. Particulate Collection:

1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,

F. Control odors and mist vapors during the cleaning and restoration process.

G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.

H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.

I. Clean all air-distribution devices, registers, grilles, and diffusers.

J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:

1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
3. Clean evaporator coils, reheat coils, and other airstream components.

K. Duct Systems:

1. Create service openings in the HVAC system as necessary to accommodate cleaning.
2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).

L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

M. Mechanical Cleaning Methodology:

1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
    a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
    b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
2. Cleaning Mineral-Fiber Insulation Components:
    a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
    b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
    c. Fibrous materials that become wet shall be discarded and replaced.

N. Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
3. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
4. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
5. Rinse thoroughly with clean water to remove any latent residues.

O. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.4 CLEANLINESS VERIFICATION

A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.

B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.

C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

D. Additional Verification:

1. Perform surface comparison testing or NADCA vacuum test.
2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.

E. Verification of Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.

F. Prepare a written cleanliness verification report. At a minimum, include the following:

1. Written documentation of the success of the cleaning.

2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
3. Surface comparison test results if required.
4. Gravimetric analysis (nonporous surfaces only).
5. System areas found to be damaged.

G. Photographic Documentation: Comply with requirements in Section 013233 "Photographic Documentation."

3.5 RESTORATION

A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.

B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts." Include location of service openings in Project closeout report.

C. Replace damaged insulation according to Section 230713 "Duct Insulation."

D. Ensure that closures do not hinder or alter airflow.

E. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

END OF SECTION 23 01 30.51

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 single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 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.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 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.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230516 - EXPANSION FITTINGS AND LOOPS

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. Section Includes:

1. Flexible, ball-joint, packed expansion joints.
2. Slip-joint packed expansion joints.
3. Expansion-compensator packless expansion joints.
4. Flexible-hose packless expansion joints.
5. Metal-bellows packless expansion joints.
6. Rubber packless expansion joints.
7. Pipe loops and swing connections.
8. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

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

1. Alignment Guide Details: Detail field assembly and attachment to building structure.
2. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKED EXPANSION JOINTS

A. Flexible, Ball-Joint, Packed Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:

a. Advanced Thermal Systems, Inc.

b. Hyspan Precision Products, Inc.

2. Standards: ASME Boiler and Pressure Vessel Code: Section II, "Materials"; and ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.

3. Material: Carbon-steel assembly with asbestos-free composition packing.

4. Design: For 360-degree rotation and angular deflection.

5. Minimum Pressure Rating: 250 psig at 400 deg F (1725 kPa at 204 deg C).

6. Angular Deflection for NPS 6 (DN 150) and Smaller: 30 degree minimum.

7. Angular Deflection for NPS 8 (DN 200) and Larger: 15 degree minimum.
8. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
9. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

B. Slip-Joint Packed Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
   a. Adsco Manufacturing LLC.
   b. Advanced Thermal Systems, Inc.
   c. Hyspan Precision Products, Inc.
2. Standard: ASTM F 1007.
3. Material: Carbon steel with asbestos-free PTFE packing.
4. Design: With internal guide and injection device for repacking under pressure. Include drip connection if used for steam piping.
5. Configuration: Single joint with base and double joint with base classes unless otherwise indicated.
6. End Connections: Flanged or weld ends to match piping system.

2.2 PACKLESS EXPANSION JOINTS

A. Metal, Expansion-Compensator Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Adsco Manufacturing LLC.
   b. Flexicraft Industries.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Unisource Manufacturing, Inc.
2. Minimum Pressure Rating: 175 psig (1200 kPa) unless otherwise indicated.
3. Configuration for Copper Tubing: Two-ply, phosphor-bronze or stainless steel bellows with copper pipe ends.
   a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded.

b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded.

4. Configuration for Steel Piping: Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.

a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.

b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.

B. Rubber, Expansion-Compensator Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.

b. Flex-Hose Co., Inc.

c. Flexicraft Industries.

d. General Rubber Corporation.

e. Mason Industries, Inc.; Mercer Rubber Co.

f. Unaflex.

g. Unisource Manufacturing, Inc.

2. Material: Twin reinforced-rubber spheres with external restraining cables.

3. Minimum Pressure Rating: 150 psig at 200 deg F (1035 kPa at 77 deg C) unless otherwise indicated.

4. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

C. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flex-Hose Co., Inc.

b. Flexicraft Industries.

c. Flex Pression Ltd.

d. Metraflex, Inc.

e. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.

3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

4. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.

   a. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 500 psig at 450 deg F (3450 kPa at 232 deg C) ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with end connections.

   a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F (2890 kPa at 21 deg C) and 315 psig at 450 deg F (2170 kPa at 232 deg C) ratings.

6. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.

   a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 515 psig at 600 deg F (3550 kPa at 315 deg C) ratings.

7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged end connections.

   a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F (1900 kPa at 21 deg C) and 200 psig at 600 deg F (1380 kPa at 315 deg C) ratings.

D. Metal-Bellows Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis-of-Design Product:

   a. Adsco Manufacturing LLC.

   b. Flex-Hose Co., Inc.

   c. Flexicraft Industries.

   d. Flex-Weld, Inc.

   e. Hyspan Precision Products, Inc.

   f. Metraflex, Inc.

g. Unaflex.

h. Unisource Manufacturing, Inc.

3. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

4. Type: Circular, corrugated bellows with external tie rods.

5. Minimum Pressure Rating: 175 psig (1200 kPa) unless otherwise indicated.

6. Configuration: Single joint with base or double joint with base classes unless otherwise indicated.

7. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

E. Rubber Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.

b. Flex-Hose Co., Inc.

c. Flexicraft Industries.

d. Flex-Weld, Inc.

e. Mason Industries, Inc.; Mercer Rubber Co.

f. Metraflex, Inc.

g. Unaflex.

h. Unisource Manufacturing, Inc.

2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

3. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.

4. Arch Type: Single or multiple arches.

5. Spherical Type: Single or multiple spheres.

6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).

7. Minimum Pressure Rating for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F (93 deg C).

8. Minimum Pressure Rating for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (966 kPa) at 180 deg F (82 deg C).
9. Material for Water: BR or Buna-N or CR or CSM or EPDM or NR.
10. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advanced Thermal Systems, Inc.
   b. Flexicraft Industries.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
   a. Stud: Threaded, zinc-coated carbon steel.
   b. Expansion Plug: Zinc-coated steel.
   c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
   a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for

surface temperature of hardened concrete where fastener is to be installed.

b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.

c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. For vertical pipe chases serving multi-story buildings, furnish and install metal-bellows expansion joints. The contractor shall verify with the expansion joint manufacturer that the model used for a vertical pipe chase is the correct application (requiring no maintenance). The contractor shall coordinate the exact piping layout with the expansion joint manufacturer to verify proper installation, which includes anchors and guides.

B. Install expansion joints of sizes matching sizes of piping in which they are installed.

C. Install packed-type expansion joints with packing suitable for fluid service.

D. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

E. Install rubber packless expansion joints according to FSA-NMEJ-702.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install guides on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.

2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

SECTION 230517 – SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AAdvance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be

incorporated into the Work include, but are not limited to, the following:

1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

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

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.

2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing.

3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
    a. Piping Smaller Than NPS 6: Sleeve-seal fittings.
    b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
2. Concrete Slabs-on-Grade:
    a. Piping Smaller Than NPS 6: Sleeve-seal fittings.
        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Sleeve-seal fittings.

b. Piping NPS 6 and Larger: Stack-sleeve fittings.

4. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 230517

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.
11. Turbine flowmeters.
12. Vortex-shedding flowmeters.

1.3 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Inc.
2. Trerice, H. O. Co.
3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
4. Weiss Instruments, Inc.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F and deg C.

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass or plastic.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   d. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel; 6-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Stainless steel.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.

c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

3. Case: Sealed type, plastic; 6-inch nominal diameter.

4. Element: Bourdon tube or other type of pressure element.

5. Movement: Mechanical, with link to pressure element and connection to pointer.

6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.

7. Pointer: Dark-colored metal.

8. Window: Glass or plastic.

9. Ring: Metal or plastic.

10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.

11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

a. Design for Air-Duct Installation: With ventilated shroud.

b. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ashcroft Inc.

b. Trerice, H. O. Co.

c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

3. Case: Sealed type, cast aluminum or drawn steel; 6-inch nominal diameter with back flange and holes for panel mounting.

4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Stainless steel.
10. Connector Type(s): Union joint, back; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Ashcroft Inc.
    b. Trerice, H. O. Co.
    c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    d. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Sealed type, plastic; 6-inch nominal diameter with back flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.

8. Window: Glass or plastic.

9. Ring: Metal or plastic.

10. Connector Type(s): Union joint, threaded, back; with ASME B1.1 screw threads.

11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.

    b. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ashcroft Inc.

    b. Trerice, H. O. Co.

    c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

    d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

3. Case: Cast aluminum; 6-inch nominal size.

4. Case Form: Back angle unless otherwise indicated.

5. Tube: Glass with magnifying lens and blue or red organic liquid.

6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F .

7. Window: Glass or plastic.

8. Stem: Aluminum or brass and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.

b. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ashcroft Inc.

b. Trerice, H. O. Co.

c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

3. Case: Plastic; 6-inch nominal size.

4. Case Form: Back angle unless otherwise indicated.

5. Tube: Glass with magnifying lens and blue or red organic liquid.

6. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F.

7. Window: Glass or plastic.

8. Stem: Aluminum or brass and of length to suit installation.

a. Design for Air-Duct Installation: With ventilated shroud.

b. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ashcroft Inc.

b. Trerice, H. O. Co.

c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.

4. Case Form: Adjustable angle unless otherwise indicated.

5. Tube: Glass with magnifying lens and blue or red organic liquid.

6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.

7. Window: Glass.

8. Stem: Aluminum and of length to suit installation.

a. Design for Air-Duct Installation: With ventilated shroud.

b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

D. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ashcroft Inc.

b. Trerice, H. O. Co.

c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

3. Case: Plastic; 9-inch nominal size unless otherwise indicated.

4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum, brass, or stainless steel and of length to suit installation.
   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ashcroft Inc.
      b. Trerice, H. O. Co.
      c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
      d. Weiss Instruments, Inc.
   2. Case: Plastic; 9-inch nominal size unless otherwise indicated.
   3. Scale(s): Deg F.
   4. Case Form: Adjustable angle.
   5. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
   6. Stem: Aluminum and of length to suit installation.
      a. Design for Air-Duct Installation: With ventilated shroud.

b. Design for Thermowell Installation: Bare stem.

7. Display: Digital.

8. Accuracy: Plus or minus 2 deg F.

B. Remote-Mounted, Light-Activated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ashcroft Inc.

b. Trerice, H. O. Co.

c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

d. Weiss Instruments, Inc.

2. Case: Plastic, for wall mounting.

3. Scale(s): Deg F.

4. Sensor: Bulb and thermistor wire.

a. Design for Air-Duct Installation: With ventilated shroud.

b. Design for Thermowell Installation: Bare stem.

5. Display: Digital.

6. Accuracy: Plus or minus 2 deg F.

2.5 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.6 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.

3. Material for Use with Copper Tubing: CNR or CUNI.

4. Material for Use with Steel Piping: CRES.

5. Type: Stepped shank unless straight or tapered shank is indicated.

6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.7 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   d. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Sealed type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.

9. Window: Glass or plastic.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   d. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   d. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Sealed type; cast aluminum or drawn steel; 6-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   d. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 6-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.8 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston -type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.9 TEST PLUGS

A. Description: Test-station fitting made for insertion into piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

E. Core Inserts: EPDM self-sealing rubber.

2.10 TEST-PLUG KITS

A. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

B. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

C. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

2.11 SIGHT FLOW INDICATORS

A. Description: Piping inline-installation device for visual verification of flow.

B. Construction: Bronze or stainless-steel body, with sight glass and ball indicator, and threaded or flanged ends.

C. Minimum Pressure Rating: 150 psig.

D. Minimum Temperature Rating: 200 deg F.

E. End Connections for NPS 2 and Smaller: Threaded.

F. End Connections for NPS 2-1/2 and Larger: Flanged.

2.12 FLOWMETERS

A. Turbine Flowmeters:

1. Description: Flowmeter with sensor and indicator.

2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

3. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.

   a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.

   b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.

c. Minimum Pressure Rating: 150 psig.

d. Minimum Temperature Rating: 180 deg F.

4. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.

5. Accuracy: Plus or minus 1-1/2 percent.

6. Display: Shows rate of flow, with register to indicate total volume in gallons.

7. Operating Instructions: Include complete instructions with each flowmeter.

B. Vortex-Shedding Flowmeters:

1. Description: Flowmeter with sensor and indicator.

2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

3. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gallons per minute.

a. Design: Flow obstruction device, vortex-measurement type for liquids.

b. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.

c. Minimum Pressure Rating: 1000 psig.

d. Minimum Temperature Rating: 500 deg F.

e. Integral Transformer: For low-voltage power operation.

4. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.

5. Accuracy: Plus or minus 0.25 percent for liquids and 0.75 percent for gases.

6. Display: Shows rate of flow, with register to indicate total volume in gallons.

7. Operating Instructions: Include complete instructions with each flowmeter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

Q. Install permanent indicators on walls or brackets in accessible and readable positions.

R. Install connection fittings in accessible locations for attachment to portable indicators.

S. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.

2. Inlet and outlet of each hydronic coil in air-handling units.

T. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be the following:

1. Sealed, bimetallic-actuated type.

2. Test plug with EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hydronic boiler shall be one of the following:

1. Sealed, bimetallic-actuated type.
2. Remote-mounted, metal -case, vapor-actuated type.
3. Industrial-style, liquid-in-glass type.

C. Thermometers at inlets and outlets of each chiller shall be one of the following:

1. Sealed, bimetallic-actuated type.
2. Remote-mounted, metal -case, vapor-actuated type.
3. Industrial-style, liquid-in-glass type.

D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:

1. Sealed, bimetallic-actuated type.
2. Direct -mounted, metal -case, vapor-actuated type.
3. Industrial-style, liquid-in-glass type.

E. Thermometers at inlets and outlets of each hydronic heat exchanger shall be one of the following:

1. Sealed, bimetallic-actuated type.
2. Direct -mounted, metal -case, vapor-actuated type.
3. Industrial-style, liquid-in-glass type.

F. Industrial-style, liquid-in-glass type.

G. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:

1. Sealed, bimetallic-actuated type.
2. Remote-mounted, metal -case, vapor-actuated type.

H. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

B. Scale Range for Air Ducts: Minus 40 to plus 110 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be the following:

1. Sealed, remote-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi.

3.8 FLOWMETER SCHEDULE

A. Flowmeters for Heating, Hot-Water Piping: Turbine or Vortex-shedding type.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze swing check valves.
4. Iron swing check valves.
5. Triple-duty valves.

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2. ASME B31.1 for power piping valves.

3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, grooves, and weld ends.

3. Set angle, gate, and globe valves closed to prevent rattling.

4. Set ball and plug valves open to minimize exposure of functional surfaces.

5. Set butterfly valves closed or slightly open.

6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.

2. Handwheel: For valves other than quarter-turn types.

3. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Solder Joint: With sockets according to ASME B16.18.

3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. See Section 016000 "Product Requirements."

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Milwaukee Valve Company.

c. NIBCO INC.

d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

3. Description:

a. Standard: MSS SP-110.

b. SWP Rating: 150 psig.

c. CWP Rating: 600 psig.

d. Body Design: Three piece.

e. Body Material: Bronze.

f. Ends: Threaded.

g. Seats: PTFE or TFE.

h. Stem: Bronze.

i. Ball: Chrome-plated brass.

j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Milwaukee Valve Company.

b. NIBCO INC.

c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.

b. CWP Rating: 150 psig.

c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.

e. Seat: EPDM.

f. Stem: One- or two-piece stainless steel.

g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Milwaukee Valve Company.

b. NIBCO INC.

c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.

b. CWP Rating: 200 psig.

c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.

e. Seat: EPDM.

f. Stem: One- or two-piece stainless steel.

g. Disc: Aluminum bronze.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Milwaukee Valve Company.

b. NIBCO INC.

c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.

b. CWP Rating: 200 psig.

c. Body Design: Horizontal flow.

d. Body Material: ASTM B 62, bronze.

e. Ends: Threaded.

f. Disc: Bronze.

2.5 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Milwaukee Valve Company.

b. NIBCO INC.

c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.

b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.

c. NPS 14 to NPS 24, CWP Rating: 150 psig.

d. Body Design: Clear or full waterway.

e. Body Material: ASTM A 126, gray iron with bolted bonnet.

f. Ends: Flanged.

g. Trim: Bronze.

h. Gasket: Asbestos free.

2.6 TRIPLE-DUTY VALVES

A. Class 125, Triple-Duty Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Milwaukee Valve Company.

b. NIBCO INC.

c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. NPS 2-1/2 to NPS 12, CWP Rating: 175 psig.

b. Valve Design: Globe

c. Body Design: Straight or angle pattern, non-adjustable

d. Body Material: Cast or ductile iron

e. Disc Material: Brass with EPDM seat

f. Stem Material: Stainless steel

g. Spring Material: Stainless steel

h. Ends: Flanged.

i. Trim: Bronze.

j. Gasket: Asbestos free.

k. Spring-loaded check valve design to prevent gravity circulation and backflow.

l. Calibrated nameplate with multi-turn stem.

m. Fully backseating disc to allow the valve packing to be replaced while under pressure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.

2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

3. Throttling Service: ball, or butterfly valves.

4. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Three piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, NBR seat, aluminum-bronze disc.
2. Iron Swing Check Valves: Class 125, metal seats.

3.6 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Three piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, NBR seat, aluminum-bronze disc.
2. Iron Swing Check Valves: Class 125, metal seats.

3. Caution: No iron, single-plate, metal-seated check valves or Class 150 or Class 300, resilient-seated, single-plate check valves are included in this Section.

END OF SECTION 230523

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.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

B. Related Sections:

1. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. National Pipe Hanger Corporation.

2. PHS Industries, Inc.

3. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

4. Piping Technology & Products, Inc.

5. Rilco Manufacturing Co., Inc.

6. Value Engineered Products, Inc.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and factory-packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install

intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field-fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. 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.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. 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.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

K. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.

b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.

3. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide 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.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).

2. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.

3. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.

4. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

5. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

6. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.

2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

3. C-Clamps (MSS Type 23): For structural shapes.

4. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

5. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

6. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

7. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

   a. Light (MSS Type 31): 750 lb (340 kg).

   b. Medium (MSS Type 32): 1500 lb (680 kg).

   c. Heavy (MSS Type 33): 3000 lb (1360 kg).

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).

2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC 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.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Open-spring isolators.
3. Resilient pipe guides.
4. Elastomeric hangers.
5. Spring hangers.
6. Restraint channel bracings.
7. Restraint cables.
8. Seismic-restraint accessories.
9. Mechanical anchor bolts.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in

tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic forces required to select vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by an agency acceptable to authorities having jurisdiction, showing maximum seismic-

restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: C.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: IV.

    a. Component Importance Factor: 1.5.
    b. Component Response Modification Factor: Per ASCE-7, Table 13.6.1: Seismic Coefficients for Mechanical and Electrical Equipment.
    c. Component Amplification Factor: Per ASCE-7, Table 13.6.1: Seismic Coefficients for Mechanical and Electrical Equipment.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.411g.
4. Design Spectral Response Acceleration at 1.0-Second Period: 0.170g.
5. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

    a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads.
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.

3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Ribbed pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.

    a. Surface Pattern: Ribbed pattern.
    b. Infused nonwoven cotton or synthetic fibers.

2.3 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.4 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-(13-mm-) thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.5 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods.

1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.6 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.7 RESTRAINT CABLES

A. Restraint Cables: ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.8 SEISMIC-RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.9 MECHANICAL ANCHOR BOLTS

A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-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

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

D. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a

manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
3. Test to 90 percent of rated proof load of device.
4. Measure isolator restraint clearance.
5. Measure isolator deflection.
6. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. 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 operation.

3.7 VIBRATION ISOLATION SCHEDULE

Application	Base	Basic Anchors	Seismic Vibration Isolator
Boiler		HPA Anchors into Concrete Floor	None – Solidly bolted into housekeeping pad and able to withstand lateral forces.
Pump	WFSL - Wide Flange Steel	HPA Anchors into Concrete Floor	SLF - Spring mounts with Z-1011 seismic snubbers.
Boiler Piping			Safe Flex SFDES Expansion Joint with CR control rods.
Pump Piping			Safe Flex SFDES Expansion Joint with CR control rods.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION 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.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: Black.

3. Background Color: White.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm) and proportionately larger lettering for greater viewing distances.

3.4 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire-link chain or beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 4 - EXECUTION

4.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

4.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
    a. Constant-volume air systems.
    b. Variable-air-volume systems.
2. Balancing Hydronic Piping systems:
    a. Variable-flow hydronic systems.
3. Testing, Adjusting, and Balancing Equipment:
    a. Air handlers.
    b. Condensing units.
    c. Boilers.
    d. Pumps.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this

Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.

B. TAB Conference: Meet with Engineer on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:
   a. The Contract Documents examination report.
   b. The TAB plan.

c. Coordination and cooperation of trades and subcontractors.

d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

1.8 GENERAL SCOPE OF TAB WORK

A. The boiler replacement portion requires both pre and post balancing of the water systems connected to the boiler.

B. Refer to the drawings for additional scope of work.

C. The installing contractor shall be responsible for assisting the TAB contractor with his work. The installing contractor is ultimately responsible for the proper functioning of his installed equipment and shall provide to the TAB contractor all required belts, sheaves, pulleys, and other similar equipment for a fully operational system in accordance with these contract drawings.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found

in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

J. Examine operating safety interlocks and controls on HVAC equipment.

K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.

b. Piping is complete with terminals installed.

c. Water treatment is complete.

d. Systems are flushed, filled, and air purged.

e. Strainers are pulled and cleaned.

f. Control valves are functioning per the sequence of operation.

g. Shutoff and balance valves have been verified to be 100 percent open.

h. Pumps are started and proper rotation is verified.

i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.

j. Variable-frequency controllers' startup is complete and safeties are verified.

k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Metal Ducts."

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "Duct Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

1.1 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

1.2 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses, close to the fan and prior to any outlets, to obtain total airflow.
c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. 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 artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
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 occurs. Measure amperage in full-cooling, full-heating,

economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

1.3 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit 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.

4. Calibrate and balance each 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.

5. After terminals 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.

6. 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.

7. 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 terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical 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.
9. 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 fans.

3.4 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.5 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design GPM.
    a. Measure total water flow.
        1) Position valves for full flow through coils.

2) Measure flow by main flow meter, if installed.

3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.

2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.

3) Convert pressure to head and correct for differences in gage heights.

4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.

b. Adjust main and branch balance valves for design flow.

c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.

b. Adjust each terminal to design flow.

c. Re-measure each terminal after it is adjusted.

d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.

e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

a. Measure differential pressure and verify that it is within manufacturer's specified range.

b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.

b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.

7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

8. Mark final settings and verify that all memory stops have been set.

9. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.

b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.

c. Mark final settings.

10. Verify that memory stops have been set.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.

2. Motor horsepower rating.
3. Motor RPM.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR BOILERS

A. Hydronic Boilers:
1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Record relief valve pressure setting.

3.8 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check the condition of coils.
5. Check the operation of the drain pan and condensate-drain trap.
6. Check bearings and other lubricated parts for proper lubrication.
7. 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 systems, inspect existing equipment that is to remain and be reused to verify that existing 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.

3.9 TOLERANCES

A. Set HVAC system's air flow rates within the following tolerances:

1. Heating-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.

2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.

4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB contractor.

3. Project name.

4. Project location.

5. Architect's name and address.

6. Engineer's name and address.

7. Contractor's name and address.

8. Report date.

9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:

a. Indicated versus final performance.

b. Notable characteristics of systems.

c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.

13. Data for terminal units, including manufacturer's name, type, size, and fittings.

14. Notes to explain why certain final data in the body of reports vary from indicated values.

D. System Diagrams: Include schematic layouts of hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Pipe and valve sizes and locations.

2. Terminal units.

3. Balancing stations.

4. Position of balancing devices.

E. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.

b. Location.

c. Make and type.

d. Model number and unit size.

e. Manufacturer's serial number.

f. Fuel type in input data.

g. Output capacity in Btu/h (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.

2. Test Data (Indicated and Actual Values):

a. Low-fire fuel input in Btu/h (kW).

b. High-fire fuel input in Btu/h (kW).

c. Manifold pressure in psig (kPa).

d. High-temperature-limit setting in deg F (deg C).

e. Operating set point in Btu/h (kW).

f. Motor voltage at each connection.

g. Motor amperage for each phase.

h. Heating value of fuel in Btu/h (kW).

F. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

3.12 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.

2. Check the following for each system:

a. Verify that balancing devices are marked with final balance position.

b. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Engineer.

2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Engineer.

3. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor supply air.
2. Indoor return air.
3. Indoor outside air.

B. Related Sections:

1. Section 230719 "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance require

ments for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General" and "Indoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.

d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct applications, provide insulation without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

2.4 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   a. Factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.

2.5 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. C & F Wire.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations.

Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Section 078413 "Penetration Firestopping" and fire-resistive joint sealers.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.

f. 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. For ducts with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Ducts Requiring Insulation:

1. Indoor supply air.
2. Indoor return air.
3. Indoor outdoor air.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Rectangular, supply, return, and outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

END OF SECTION 23 07 13

SECTION 230716 - HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating HVAC equipment that is not factory insulated.

B. Related Sections:
   1. Section 230719 "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

   1. Detail removable insulation at equipment connections.
   2. Detail application of field-applied jackets.
   3. Detail application at linkages of control devices.
   4. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

   1. Sheet Form Insulation Materials: 12 inches (300 mm) square.
   2. Sheet Jacket Materials: 12 inches (300 mm) square.
   3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Breeching Insulation Schedule," "Indoor Equipment Insulation Schedule," article for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I or Type II.

1. Prefabricated Fitting Covers: Comply with ASTM C450 and ASTM C585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
1. Block Insulation: Type I.
2. Special-Shaped Insulation: Type III.
3. Board Insulation: Type IV.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber Blanket: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II, and ASTM C1290, Type II, with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber Board: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. Provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Mineral-Fiber, Pipe and Tank: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C1393.
1. Semirigid board material with factory-applied ASJ jacket.
2. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more.
3. Thermal conductivity (k-value) at 100 deg F (38 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

E. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm (0.66 metric perms) at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
   3. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
   2. Service Temperature Range: 20 to plus 180 deg F (Minus 6 to plus 82 deg C).
   3. Color: White.

2.7 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
   1. Permanently flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
   3. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
   3. Color: Aluminum.

D. ASJ Flashing Sealants and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
   3. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 4 oz./sq. yd. (114 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering equipment.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment.

2.10 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

2.11 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated tank heads and tank side panels.

D. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches (75 mm).
2. Thickness: 11.5 mils (0.29 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. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches (50 mm).
2. Thickness: 6 mils (0.15 mm).
3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

C. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Width: 3 inches (75 mm).
2. Film Thickness: 6 mils (0.15 mm).
3. Adhesive Thickness: 1.5 mils (0.04 mm).
4. Elongation at Break: 145 percent.
5. Tensile Strength: 55 psi (379 kPa width.

2.13 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding; 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding; 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank; length to suit depth of insulation indicated.
   c. Adhesive: Recommended by hanger manufacturer. Use product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
   a. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.

b. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank; length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
c. Adhesive: Recommended by hanger manufacturer. Use product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed; 0.106-inch- (2.6-mm-) diameter shank; length to suit depth of insulation indicated.
c. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

2.14 CORNER ANGLES

A. Aluminum Corner Angles: 0.040-inch- (1.0-mm-) thick, minimum 1- by 1-inch (25- by 25-mm) aluminum in accordance

with ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range of between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, and jackets, of thicknesses required for each item of equipment, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation

inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches (100 mm) o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

O. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive, anchor pins, and speed washers.

1. Apply adhesives in accordance with manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints and 16 inches (400 mm) o.c. in both directions.
    d. Do not over-compress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins, and attach speed washers.
    g. 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. Secure each layer of insulation with stainless steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a field-adjustable latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.040 inch (1.0 mm) thick.
3. For below-ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Boiler Breechings:

1. Secure single-layer insulation with stainless steel bands at 12-inch (300-mm) intervals, and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless steel bands at 12-inch (300-mm) intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches (300 mm) o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections: Inspect field-insulated equipment, randomly selected by the Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in "Indoor Equipment Insulation Schedule" and "Outdoor, Aboveground Equipment Insulation Schedule? articles. For large equipment, remove only a portion adequate to determine compliance.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.10 EQUIPMENT INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials is Contractor's option.

3.11 BREECHING INSULATION SCHEDULE

A. Round, exposed breeching and connector insulation shall be one of the following:

1. Calcium Silicate: 4 inches (100 mm) thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

B. Round, concealed breeching and connector insulation shall be one of the following:

1. Calcium Silicate: 4 inches (100 mm) thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

3.12 INDOOR EQUIPMENT INSULATION SCHEDULE

A. Insulate indoor equipment that is not factory insulated.

B. Heating-hot-water pump insulation shall be one of the following:

1. Calcium Silicate: 3 inches (75 mm) thick.
2. Cellular Glass: 3 inches (75 mm) thick.
3. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

C. Heating-hot-water expansion tank insulation shall be one of the following:

1. Calcium Silicate: 2 inches (50 mm) thick.
2. Cellular Glass: 2 inches (50 mm) thick.
3. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
4. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.

D. Heating-hot-water air-separator insulation shall be one of the following:

1. Calcium Silicate: 3 inches (75 mm) thick.
2. Cellular Glass: 3 inches (75 mm) thick.

3. Mineral-Fiber Board: 2 inches (50 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.
4. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

END OF SECTION 230716

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate and equipment drain water below 60 Deg F (16 Deg C).
2. Heating hot-water piping, indoors.
3. Refrigerant piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Qualification Data: For qualified Installer.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," and "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000-Degree Pipe Insulation.
   c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Knauf Insulation; Permawick Pipe Insulation.
b. Owens Corning; VaporWick Pipe Insulation.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; MicroFlex.
b. Knauf Insulation; Pipe and Tank Insulation.
c. Owens Corning; Fiberglas Pipe and Tank Insulation.

J. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.

c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Super-Stik.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
   c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.

d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:
1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.

b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick,3/4 inch wide with wing seal .

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

   a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with

continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh.

Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Color: Final color as selected by Owner. Vary first and second coats to allow visual inspection of the completed Work.

B. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each

piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 2 inches thick.
b. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

C. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

D. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed in mechanical rooms:

1. PVC: 30 mils thick.

3.13 OUTDOOR PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Exposed:

1. PVC: 30 mils thick.

END OF SECTION 230719

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Concrete bases.

1.3 DEFINITIONS

A. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Incoming supplied line pressure from the utility company is 5 psi.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Welding certificates.

E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motorized gas valves, pressure regulators to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.10 PROJECT CONDITIONS

A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.

2. Do not proceed with interruption of natural-gas service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   a. Material Group: 1.1.
   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.
   d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
   e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
5. Mechanical Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dresser Piping Specialties; Division of Dresser, Inc.
      2) Smith-Blair, Inc.
   b. Stainless-steel flanges and tube with epoxy finish.
   c. Buna-nitrile seals.

d. Stainless-steel bolts, washers, and nuts.

e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. OmegaFlex, Inc.

b. Parker Hannifin Corporation; Parflex Division.

c. Titeflex.

d. Tru-Flex Metal Hose Corp.

2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.

3. Coating: PE with flame retardant.

a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: 25 or less.

2) Smoke-Developed Index: 50 or less.

4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.

5. Striker Plates: Steel, designed to protect tubing from penetrations.

6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.

7. Operating-Pressure Rating: 5 psig (34.5 kPa).

C. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type L.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.

2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.

a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.

D. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type L.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.

2. Flare Fittings: Comply with ASME B16.26 and SAE J513.

a. Copper fittings with long nuts.

b. Metal-to-metal compression seal without gasket.

c. Dryseal threads complying with ASME B1.20.3.

3. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Dresser Piping Specialties; Division of Dresser, Inc.

2) Smith-Blair, Inc.

b. Stainless-steel flanges and tube with epoxy finish.

c. Buna-nitrile seals.

d. Stainless-steel bolts, washers, and nuts.

e. Factory-installed anode for steel-body couplings installed underground.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Corrugated stainless-steel tubing with polymer coating.
3. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
4. End Fittings: Zinc-coated steel.
5. Threaded Ends: Comply with ASME B1.20.1.
6. Maximum Length: 72 inches (1830 mm.)

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

D. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig (862 kPa)
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig (862 kPa)
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. BrassCraft Manufacturing Company; a Masco company.

b. Conbraco Industries, Inc.; Apollo Div.

c. Lyall, R. W. & Company, Inc.

d. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.

3. Ball: Chrome-plated bronze.

4. Stem: Bronze; blowout proof.

5. Seats: Reinforced TFE; blowout proof.

6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

8. CWP Rating: 600 psig (4140 kPa).

9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Lee Brass Company.

b. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.

3. Plug: Bronze.

4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and

"Aboveground Manual Gas Shutoff Valve Schedule" Articles.

5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig (862 kPa).
7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. McDonald, A. Y. Mfg. Co.
   b. Mueller Co.; Gas Products Div.
   c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Flowserve.

b. McDonald, A. Y. Mfg. Co.

c. Milliken Valve Company.

d. Mueller Co.; Gas Products Div.

2. Body: Cast iron, complying with ASTM A 126, Class B.

3. Plug: Bronze or nickel-plated cast iron.

4. Seat: Coated with thermoplastic.

5. Stem Seal: Compatible with natural gas.

6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

7. Operator: Square head or lug type with tamperproof feature where indicated.

8. Pressure Class: 125 psig (862 kPa).

9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ASCO Power Technologies, LP; Division of Emerson.

b. Eaton Corporation; Controls Div.

c. Eclipse Combustion, Inc.

d. Honeywell International Inc.

e. Johnson Controls.

2. Body: Brass or aluminum.

3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. Normally closed.
6. Visual position indicator.
7. Electrical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. ASCO Power Technologies, LP; Division of Emerson.
   b. Dungs, Karl, Inc.
   c. Eclipse Combustion, Inc.
   d. Goyen Valve Corp.; Tyco Environmental Systems.
   e. Magnatrol Valve Corporation.
   f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
   g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
3. Pilot operated.
4. Body: Brass or aluminum.
5. Seats and Disc: Nitrile rubber.
6. Springs and Valve Trim: Stainless steel.
7. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
8. NEMA ICS 6, Type 4, coil enclosure.
9. Normally closed.
10. Visual position indicator.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Actaris.
   b. American Meter Company.
   c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   d. Invensys.
   e. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

12. Maximum Inlet Pressure: 100 psig (690 kPa)

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Actaris.

b. American Meter Company.

c. Eclipse Combustion, Inc.

d. Fisher Control Valves and Regulators; Division of Emerson Process Management.

e. Invensys.

f. Maxitrol Company.

g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.

4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

6. Orifice: Aluminum; interchangeable.

7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.

9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Overpressure Protection Device: Factory mounted on pressure regulator.

11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Capitol Manufacturing Company.

   b. Central Plastics Company.

   c. Hart Industries International, Inc.

   d. Jomar International Ltd.

   e. Matco-Norca, Inc.

   f. McDonald, A. Y. Mfg. Co.

   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

   h. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.

   b. Pressure Rating: 150 psig (1035 kPa).

   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Capitol Manufacturing Company.

   b. Central Plastics Company.

   c. Matco-Norca, Inc.

   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

   e. Wilkins; a Zurn company.

2. Description:
    a. Standard: ASSE 1079.
    b. Factory-fabricated, bolted, companion-flange assembly.
    c. Pressure Rating: 150 psig (1035 kPa).
    d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.
2. Description:
    a. Nonconducting materials for field assembly of companion flanges.
    b. Pressure Rating: 150 psig (1035 kPaGasket: Neoprene or phenolic.
    c. Bolt Sleeves: Phenolic or polyethylene.
    d. Washers: Phenolic with steel backing washers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Locate valves for easy access.

G. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Verify final equipment locations for roughing-in.

K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

1. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

a. Exception: Tubing passing through partitions or walls does not require striker barriers.

2. Prohibited Locations:

a. Do not install natural-gas piping in or through chimneys or gas vents (flues).

b. Do not install natural-gas piping in solid walls or partitions.

O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

P. Connect branch piping from top or side of horizontal piping.

Q. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

R. Do not use natural-gas piping as grounding electrode.

S. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

T. Install pressure gage upstream and downstream from each line regulator.

1. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) AMETEK, Inc.

2) Ernst Flow Industries.

3) Palmer Wahl Instrumentation Group

4) Or Approved Equivalent.

b. Standard: ASME B40.100.

c. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.

d. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

e. Match pressure connection size in first subparagraph below with gage attachment size.

f. Pressure Connection: Brass, with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.

g. Minimum Pressure Rating: Twice the operating pressure.

h. Movement: Mechanical, with link to pressure element and connection to pointer.

i. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).

j. Pointer: Dark-colored metal.

k. Window: Glass.

l. Ring: Stainless steel.

m. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

C. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 and NPS 5/8 (DN 15 and DN 18): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 3/4 and NPS 7/8 (DN 20 and DN 22): Maximum span, 84 inches (2134 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 1 (DN 25): Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).

2. NPS 1/2 (DN 15): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 3/4 (DN 20) and Larger: Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

3.7 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.9 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, Quick-drying alkyd metal primer.
    b. Intermediate Coat: Interior latex matching topcoat.
    c. Topcoat: Interior latex gloss).
    d. Color: Yellow.
2. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Alkyd anticorrosive, Quick-drying alkyd metal primer.

b. Intermediate Coat: Interior alkyd matching topcoat.

c. Topcoat: Interior alkyd gloss.

d. Color: Yellow.

B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54, the International Fuel Gas Code, and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

2. Bronze plug valve.

3. Cast-iron, non-lubricated plug valve.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain valves.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Condensate-drain piping.
3. Air-vent piping.

1.3 ACTION SUBMITTALS

A. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

B. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.

3. Structural members.

C. Qualification Data: For Installer.

D. Welding certificates.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 100 psig (kPa) at 200 deg F (93 deg C).

2. Air-Vent Piping: 200 deg F (93 deg C).

3. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

a. Standard: ASSE 1079.

b. Pressure Rating: 150 psig (1035 kPa).

c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

a. Standard: ASSE 1079.

b. Factory-fabricated, bolted, companion-flange assembly.

c. Pressure Rating: 150 psig (1035 kPa).

d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Description:

a. Nonconducting materials for field assembly of companion flanges.

b. Pressure Rating: 150 psig (1035 kPa).

c. Gasket: Neoprene or phenolic.

d. Bolt Sleeves: Phenolic or polyethylene.

e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Description:

a. Standard: IAPMO PS 66.

b. Electroplated steel nipple, complying with ASTM F 1545.

c. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).

d. End Connections: Male threaded or grooved.

e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

2. Outlet: Type LK (Type A), annealed-temper copper tubing with soldered or flared joints.

D. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523 “General Duty Valves for HVAC Piping”.

Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517.

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517.

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518.

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100) : Use dielectric flange kits.

D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 “Vibration Controls for HVAC”. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m).

5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m).
6. NPS 3 (DN 80) and Larger: Maximum span, 12 feet (3.7 m).

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/4 ((DN 32):)Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 3 (DN 80) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. 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.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs

and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.

2. Inspect pumps for proper rotation.

3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely

(automatic type), or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Make-up water piping.
3. Condensate-drain piping.
4. Blowdown-drain piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves.
2. Air-control devices.
3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 100 psig at 200 deg F
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Blowdown-Drain Piping: 200 deg F.
5. Air-Vent Piping: 200 deg F.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

A. Globe, check, ball, and butterfly valves: Comply with requirements specifies in Section 230523 “General Duty Valves for HVAC Piping”.

B. Bronze, Calibrated-Orifice, Balancing Valves:

1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
2. Ball: Brass or stainless steel.

3. Plug: Resin.
4. Seat: PTFE.
5. End Connections: Threaded or socket.
6. Pressure Gage Connections: Integral seals for portable differential pressure meter.
7. Handle Style: Lever, with memory stop to retain set position.
8. CWP Rating: Minimum 125 psig.
9. Maximum Operating Temperature: 250 deg F.

C. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
2. Ball: Brass or stainless steel.
3. Stem Seals: EPDM O-rings.
4. Disc: Glass and carbon-filled PTFE.
5. Seat: PTFE.
6. End Connections: Flanged or grooved.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

D. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Low inlet-pressure check valve.
7. Inlet Strainer: removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with

operating pressure and capacity factory set and field adjustable.

E. Diaphragm-Operated Safety Valves: ASME labeled.

1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Wetted, Internal Work Parts: Brass and rubber.
7. Inlet Strainer: removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Automatic Flow-Control Valves:

1. Body: Brass or ferrous metal.
2. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
3. Combination Assemblies: Include bronze or brass-alloy ball valve.
4. Identification Tag: Marked with zone identification, valve number, and flow rate.
5. Size: Same as pipe in which installed.
6. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
7. Minimum CWP Rating: 175 psig.
8. Maximum Operating Temperature: 200 deg.

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.

5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

C. Expansion Fittings: Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping." Section 15124 "Expansion Fittings and Loops for HVAC Piping."

D. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested after taps are fabricated and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch diameter gage glass, and slotted-metal glass guard.

E. Bladder-Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to

ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

F. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.

2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.

3. Tangential Inlet and Outlet Connections: Flanged connections for NPS 2-1/2 and larger.

4. Blowdown Connection: Threaded.

5. Size: Match system flow capacity.

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.

4. CWP Rating: 125 psig.

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig.

C. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

D. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install throttling-duty valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

D. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Xylem Corporation; Bell & Gossett.
4. PACO Pumps.
5. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Open, drip proof.

b. Enclosure Materials: Cast iron.

c. Motor Bearings: Grease-lubricated ball bearings.

d. Efficiency: Premium efficient.

e. Service Factor: 1.15.

2.2 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.

2. 175-psig pressure rating, cast -iron body and end cap, pump-inlet fitting.

3. Bronze startup and bronze or stainless-steel permanent strainers.

4. Bronze or stainless-steel straightening vanes.

5. Drain plug.

6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.

2. 175-psig pressure rating, cast or ductile -iron body, pump-discharge fitting.

3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.

4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine equipment rooms for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Equipment Mounting:

1. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration Controls for HVAC."

3.3 ALIGNMENT

A. Perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten bolts evenly but not too firmly.

3.4 CONNECTIONS

A. Where installing piping adjacent to pump, allow space for service and maintenance.

B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

D. Install triple-duty valve on discharge side of pumps.

E. Install suction diffuser and shutoff valve on suction side of pumps.

F. Install flexible connectors on suction and discharge sides of pumps between casing and valves.

G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

H. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:
    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.

6. Start motor.

7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
2. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50).

2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.8 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.9 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B).

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.

2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.

5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig (2760 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig (2760 kPa).
6. Maximum Operating Temperature: 240 deg F (116 deg C).

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F (4.4 deg C).
6. Superheat: Adjustable.
7. End Connections: Socket, flare, or threaded union.
8. Working Pressure Rating: 450 psig (3100 kPa).

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.

1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal.
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V ac coil.
8. End Connections: Socket.

9. Throttling Range: Maximum 5 psig (34 kPa).
10. Working Pressure Rating: 500 psig (3450 kPa).
11. Maximum Operating Temperature: 240 deg F (116 deg C).

I. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig (3450 kPa).
5. Maximum Operating Temperature: 275 deg F (135 deg C).

J. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Maximum Operating Temperature: 275 deg F (135 deg C).

K. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.

6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Rated Flow: 4 tons.
9. Working Pressure Rating: 500 psig (3450 kPa).
10. Maximum Operating Temperature: 240 deg F (116 deg C).

2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 2-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

E. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

F. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

G. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

H. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

I. Install receivers sized to accommodate pump-down charge.

J. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. 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. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.

M. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

N. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

P. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Spring hangers to support vertical runs.
4. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

a. Fill system with nitrogen to the required test pressure.
b. System shall maintain test pressure at the manifold gage throughout duration of test.
c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.

5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

SECTION 232513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the following water treatment for closed-loop hydronic systems:

1. Manual chemical-feed equipment.
2. Chemicals.

1.3 DEFINITIONS

A. 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.

B. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:

1. Bypass feeders.
2. pH controllers.
3. TSS controllers.
4. Chemical test equipment.
5. Chemical material safety data sheets.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to hydronic systems.

1. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.

B. Field quality-control reports.

C. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
2. Water Analysis: Illustrate water quality available at Project site.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

1.8 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.

6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ampion Corp.
2. Anderson Chemical Company
3. Aqua-Chem, Inc.
4. Barclay Water Management
5. Boland Trane Services
6. Cascade Water Services
7. Earthwise Environmental Inc.
8. General Electric Company
9. H-O-H Water Technology
10. Metro Group, Inc.
11. Nalco
12. Sonitec-Vortisand Inc.
13. Watcon, Inc.
14. Water Services Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.

6. TSS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:
    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
    d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
    e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

2.3 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 2 gal. 5 gal.
2. Minimum Working Pressure: 125 psig.

2.4 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
2. Install water meter in makeup-water supply.
3. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
5. Install a swing check on the inlet after the isolation valve.

3.3 CONNECTIONS

A. Where installing piping adjacent to equipment, allow space for service and maintenance.

B. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings.

C. Install shutoff valves on HVAC water-treatment equipment inlet and outlet.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect field-assembled components and equipment installation, including piping connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.

3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. At eight-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.

F. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Acidity and Alkalinity: ASTM D 1067.
3. Iron: ASTM D 1068.
4. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION 232513

SECTION 232923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 DIVISION 23 AND DIVISION 26 RESPONSIBILITIES

A. VFCs shall be furnished by Mechanical Division 23. Start-up, adjusting, demonstration, training and control wiring shall be by Mechanical Division 23

B. VFC installation, testing, power wiring and breaker setting shall be by Electrical Division 26.

C. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Data: Certificates, for each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
b. Manufacturer's written instructions for setting field-adjustable overload relays.
c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:

1. Basis of Design: Toshiba Q9 Plus HVAC Drive.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A or UL 508C.

B. Application: variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
7. Ambient Temperature Rating: Not less than 5 deg F (-15 deg C) and not exceeding 104 deg F (40 deg C).
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet (1000 m).
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.
11. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
2. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

a. A minimum of two programmable analog inputs: 0- to 10-V dc.
b. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:

a. 0- to 10-V dc.
b. 4- to 20-mA dc.
c. Potentiometer using up/down digital inputs.
d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of two programmable analog output signal(s) (0- to 10-V dc), which can be configured for any of the following:

    a. Output frequency (Hz).
    b. Output current (load).
    c. DC-link voltage (V dc).
    d. Motor torque (percent).
    e. Motor speed (rpm).
    f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

    a. Motor running.
    b. Set point speed reached.
    c. Fault and warning indication (overtemperature or overcurrent).
    d. PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: Two.

G. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.

1. Hardwired Points:

    a. Monitoring: On-off status.
    b. Control: On-off operation.

2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.6 OTHER FEATURES

A. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

B. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

C. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

D. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.7 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.8 ACCESSORIES

A. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 1 and Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

B. Cooling Fan and Exhaust System: For NEMA 250, Type 1 and Type 3R ; UL 508 component recognized: Supply fan, with intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

C. Spare control-wiring terminal blocks; unwired.

2.9 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to its specified motor.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Floor-Mounting Controllers: Install VFCs on 4-inch (100-mm) nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."

D. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Install fuses in each fusible-switch VFC.

G. Install fuses in control circuits if not factory installed.

H. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

J. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer and Owner before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. VFCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with

adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer and Owner before increasing settings.

D. Set field-adjustable circuit-breaker trip ranges.

E. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 232923

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.
2. Seismic-restraint devices.

B. Shop Drawings:

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 static-pressure classes.
4. Elevation of top 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. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, 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 installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Penetrations of smoke barriers and fire-rated construction.
5. Items penetrating finished ceiling including the following:

a. Lighting fixtures.

b. Air outlets and inlets.

c. Speakers.

d. Sprinklers.

e. Access panels.

f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other

provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).

C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

D. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.

2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.

4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

5. Shop-Applied Coating Color: Black.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 DUCT LINER

A. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Acoustical Surfaces, Inc.

b. Bonded Logic, Inc.

c. Ductmate Industries, Inc.

2. Maximum Thermal Conductivity:

a. Type I, Flexible: 0.24 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature when tested according to ASTM C518.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).

7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

a. Fan discharges.

b. Intervals of lined duct preceding unlined duct.

c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.

10. 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.

2.4 SEALANT AND GASKETS

A. 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.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

2. Tape Width: 3 inches (76 mm).

3. Sealant: Modified styrene acrylic.

4. Water resistant.

5. Mold and mildew resistant.

6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.

7. Service: Indoor and outdoor.

8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.

4. Water resistant.

5. Mold and mildew resistant.

6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.

8. Service: Indoor or outdoor.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Base: Synthetic rubber resin.

3. Solvent: Toluene and heptane.

4. Solids Content: Minimum 60 percent.

5. Shore A Hardness: Minimum 60.

6. Water resistant.

7. Mold and mildew resistant.

8. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.

9. Service: Indoor or outdoor.

10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

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.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

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. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

J. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction,"

Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Return-Air Ducts: Seal Class C.
4. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Support vertical ducts with steel 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 intervals of 16 feet (5 m).

E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
3. Test for leaks before applying external insulation.
4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
5. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. 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: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. 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 duct. Patch insulation as recommended by duct manufacturer. Comply with Section 233300 "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.

C. 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.

D. 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, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and 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.

E. 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, or duct accessories.

4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

5. Provide drainage and cleanup for wash-down procedures.

6. 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.

3.7 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

1. Exterior ductwork shall be aluminum construction.

B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 2-inch wg (500 Pa).

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 6.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 6.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 1-inch wg (250 Pa).

b. Minimum SMACNA Seal Class: [A] [B] [C] if negative pressure, and A if positive pressure.

c. SMACNA Leakage Class for Rectangular: 12.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and

Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

G. Liner:

1. Supply Air Ducts: Natural fiber, 1 inch (25 mm) thick.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch: Spin in.

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.

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Flange connectors.
3. Turning vanes.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Flexible ducts.
7. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.

b. Manual volume damper installations.

c. Wiring Diagrams: For power, signal, and control wiring.

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.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).

2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Air Balance Inc.; a division of Mestek, Inc.
    b. Flexmaster U.S.A., Inc.
    c. Nailor Industries Inc.
    d. Ruskin Company.
2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:
    a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
    a. Oil-impregnated bronze.
    b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of

damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 0.5-inch (13-mm) diameter.

2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.

2. Include center hole to suit damper operating-rod size.

3. Include elevated platform for insulated duct mounting.

2.4 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.

2. Nexus PDQ; Division of Shilco Holdings Inc.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.5 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. METALAIRE, Inc.
2. SEMCO Incorporated.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall.

2.6 DUCT SILENCERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flex-Tek Group.
2. McGill Airflow LLC.
3. Ruskin Company.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G60 (Z180), galvanized sheet steel, 0.034 inch (0.85 mm) thick.

E. Inner Casing and Baffles: ASTM A 653/A 653M, G60 (Z180) galvanized sheet metal, 0.034 inch (0.85 mm) thick, and with 1/8-inch- (3-mm-) diameter perforations.

F. Special Construction:

1. High transmission loss to achieve STC 45.

G. Connection Sizes: Match connecting ductwork unless otherwise indicated.

H. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.

2. Dissipative type with fill material.

a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.

b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

I. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Joints: Lock formed and sealed.

2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.

3. Reinforcement: Cross or trapeze angles for rigid suspension.

J. Accessories:

1. Factory-installed end caps to prevent contamination during shipping.

K. Source Quality Control: Test according to ASTM E 477.

1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm (10-m/s) face velocity.

2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg (1500-Pa) static pressure, whichever is greater.

L. Capacities and Characteristics:

1. Configuration: Straight.

2. Shape: Rectangular.

3. Attenuation Mechanism: Acoustical glass fiber.

4. Maximum Pressure Drop: 0.35-inch wg (0.09 kPa).

5. Casing:

a. Attenuation: Standard.

b. Outer Material: Galvanized steel.

c. Inner Material: Galvanized steel.

6. Accessories:

a. Access door.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Greenheck Fan Corporation.

2. Nailor Industries Inc.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.

b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.

c. Hinges and Latches: 1-by-1-inch (25-by-25-mm)butt or piano hinge and cam latches.

d. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.

2. Ventfabrics, Inc.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.9 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexmaster U.S.A., Inc.

2. McGill AirFlow LLC.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.

2. Maximum Air Velocity: 4000 fpm (20 m/s).

3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. 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.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire dampers according to UL listing.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.

2. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
3. At each change in direction and at maximum 50-foot (15-m) spacing.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).

J. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. Connect terminal units to supply ducts directly or with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

M. Connect flexible ducts to metal ducts with draw bands.

N. Install duct test holes where required for testing and balancing purposes.

O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 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.

END OF SECTION 233300

SECTION 23 34 16 - CENTRIFUGAL HVAC FANS

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: For each product.

1. Backward-inclined centrifugal fans.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes, including color charts.
6. Dampers, including housings, linkages, and operators.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

B. PRODUCTS

1.6 PERFORMANCE REQUIREMENTS

A. AMCA Compliance:

1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
2. Operating Limits: Classify according to AMCA 99.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. BACKWARD-INCLINED CENTRIFUGAL FANS

D. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.
4. Or Approved Equal.

E. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

F. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

G. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.
2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

H. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

I. Pre-lubricated and Sealed Shaft Bearings:

1. Ball-Bearing Rating Life: ABMA 9, Ll0 at 100,000 hours

J. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
3. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
4. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
5. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

K. MOTORS

L. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

M. Motor shall be capable of variable-speed operation.

1.7 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 2 - EXECUTION

2.1 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:

1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Retain "Isolation Curb Support" Paragraph below for units mounted on isolation curbs.

F. Isolation Curb Support: Install centrifugal fans on isolation curbs, and install flexible duct connectors and vibration isolation devices.

1. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.
2. Comply with requirements in Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.

G. Install units with clearances for service and maintenance.

H. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

2.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. FIELD QUALITY CONTROL

D. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

E. Retain "Perform the following tests and inspections" Paragraph below to require Contractor to perform tests and inspections.

F. Perform the following tests and inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system.
5. Adjust damper linkages for proper damper operation.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
8. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
9. Remove and replace malfunctioning units and retest as specified above.

G. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

END OF SECTION 23 34 16

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Listed double-wall vents.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Special gas vents.
2. Guy wires and connectors.

B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers, and location and size of each field connection.
2. For installed products indicated to comply with design loads, include calculations required for selecting restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Heat-Fab, Inc.

2. Metal-Fab, Inc.

3. Selkirk Inc.; Selkirk Metalbestos and Air Mate.

B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1 inch airspace.

D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

E. Outer Jacket: Aluminized steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.

2.2 GUYING AND BRACING MATERIALS

A. Cable: Three galvanized, stranded wires of the following thickness:

1. Minimum Size: 1/4 inch in diameter.
2. For ID Sizes 4 to 15 Inches: 5/16 inch.
3. For ID Sizes 18 to 24 Inches: 3/8 inch.
4. For ID Sizes 27 to 30 Inches: 7/16 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Special Gas Vent: Condensing gas appliances.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in direction of flow.

F. Connect base section to foundation using anchor lugs of size and number recommended by manufacturer.

G. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.

H. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes gas-fired, water-tube condensing boilers, trim, and accessories for generating hot water.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and mounting attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

D. Other Informational Submittals:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Water-Tube Condensing Boilers:

a. 12 months against defects in workmanship and material for boiler, trim, boiler control system, and all related components, accessories, and appurtenances.

b. Five years for heat exchanger and fuel burner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

E. Mounting Base: For securing boiler to concrete base.

2.2 WATER-TUBE CONDENSING BOILERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

1. Bryan Boilers
2. Cleaver Brooks
3. Lochinvar

B. Special Considerations:

1. Contractor shall visit the site, thoroughly investigate the rigging path, and certify that the product submitted can be physically moved from the loading dock to the location indicated on the drawings without disassembly of unit or modifications to the building.

C. Description: Factory-fabricated, -assembled, and -tested, water-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water-heating service only.

D. Heat Exchanger: Finned- 304L stainless steel primary and 316L stainless-steel secondary heat exchangers.

E. Combustion Chamber: Stainless steel, sealed.

F. Burner: Natural gas, forced draft drawing from gas premixing valve.

G. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.

1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

H. Gas Train: Combination gas valve with manual shutoff and pressure regulator, two safety solenoid valves, low gas

pressure switch (with manual reset), high pressure gas switch (with manual reset), two pressure test ports.

I. Ignition: Silicone carbide hot-surface or direct spark ignition that includes flame safety supervision and 100 percent main-valve shutoff.

J. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.

2. Control Compartment Enclosures: NEMA 250, Type 1A.

3. Finish: Textured epoxy.

4. Insulation: Minimum 2-inch- thick, mineral-fiber insulation surrounding the heat exchanger.

5. Combustion-Air Connections: Inlet and vent duct collars.

2.3 TRIM

A. Include devices sized to comply with ASME B31.9.

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch- diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Manual.

F. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

2.4 CONTROLS

A. Boiler operating controls shall include the following devices and features:

1. Control transformer.

2. Set-Point Adjust: Set points shall be adjustable.

3. Operating Pressure Control: Factory wired and mounted to cycle burner.

4. Low-Water Cutoff and Pump Control: Cycle feedwater pump(s) for makeup water control.
5. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to deliver supply-water temperature setpoint.

B. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

C. Capabilities

1. Flame Supervision
2. Burner Sequencing
3. Heating / Modulation Control
4. Hot Water System Pump Control
5. High Limit Temperature Control
6. Thermowell-Mounted NTC Temperature Sensors To Provide Measured Process Variable Signals To The Controller
7. User-Friendly Touchscreen Interface
8. Modbus Communication Capability
9. Alarm / Lockout Messaging With History (Last 15 Messages)
10. Annunciation
11. Outdoor Reset
12. Password Protection of Configurable Parameters (Three Levels)
    a. End-User
    b. Installer / Service Engineer

c. OEM Manufacturer

13. High Stack Temperature Limit
14. Remote Reset
15. Lead / Lag Sequencing
16. (3) Configurable Pump Relays
17. Remote Modulation / Remote Setpoint
18. Frost Protection
19. Time of Day (Dual Setpoint) Control

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to fused disconnect switch.
5. Provide each motor with overcurrent protection.

2.6 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Equipment Mounting:

1. Install boilers on cast-in-place concrete equipment base(s).

2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Boiler Venting:

1. Install flue venting kit and combustion-air intake.

2. Connect full size to boiler connections. Comply with requirements in Section 235100 "Breechings, Chimneys, and Stacks."

I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform installation and startup checks according to manufacturer's written instructions.

2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

   a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.

   b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Boiler will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. 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 Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION 235216

SECTION 23 73 13.13 - INDOOR, BASIC AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes factory-assembled, indoor air-handling units with limited features, including the following components and accessories:

1. Casings.
2. Fans, drives, and motors.
3. Coils.
4. Air filtration.
5. Dampers.

1.3 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:

    a. Include certified fan-performance curves with system operating conditions indicated.
    b. Include certified fan-sound power ratings.
    c. Include fan construction and accessories.
    d. Include motor ratings, electrical characteristics, and motor accessories.

6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.
8. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each type and configuration of indoor, basic, air-handling unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of indoor, basic air-handling units, as well as procedures and diagrams.
4. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For vibration isolation indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Seismic Qualification Data: Certificates for indoor, basic air-handling units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Restraint of internal components.

C. Source quality-control reports.

D. Startup service reports.

E. Field quality-control reports.

F. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set for each air-handling unit.
2. Gaskets: One set for each access door.
3. Fan Belts: One set for each air-handling unit fan.

1.7 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of indoor, basic, air-handling units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

F. Structural Performance: Casing panels shall be self-supporting and capable of withstanding positive/negative 4-inch wg (996 Pa) of internal static pressure, without exceeding a midpoint deflection of 0.005 inches/inch (0.005 mm/mm) of panel span.

G. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Component Importance Factor: 1.5.

2.2 CAPACITIES AND CHARACTERISTICS

A. As scheduled.

2.3 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

1. Carrier Corporation
2. Daikin AC, Inc.

3. Trane Company

2.4 UNIT CASINGS

A. General Fabrication Requirements for Casings;

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Joints: Sheet metal screws or pop rivets.
3. Sealing: Seal all joints with water-resistant sealant. Hermetically seal at each corner and around entire perimeter.
4. Base Rail:

a. Material: Galvanized steel.
b. Height: 4 inches (150 mm).

B. Double-Wall Construction:

1. Outside Casing Wall: Galvanized steel, minimum 18 gauge (1.3 mm) thick, with manufacturer's standard finish.
2. Inside Casing Wall: G90 (Z275) galvanized steel, solid, minimum 18 gauge (1.3 mm) thick.
3. Floor Plate: G90 (Z275) galvanized steel, minimum 18 gauge (1.3 mm) thick.
4. Casing Insulation:

a. Materials: Glass-fiber blanket or board insulation, Type I or Type II ASTM C1071 or injected polyurethane foam insulation.
b. Insulation Thickness: 1 inch (25 mm).
c. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. Static-Pressure Classifications:

1. For Unit Sections Upstream of Fans: Minus 2-inch wg (500 Pa).
2. For Unit Sections Downstream and Including Fans: 2-inch wg (500 Pa).

E. Panels and Doors:

1. Panels:

    a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
    b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow.
    c. Gasket: Neoprene, applied around entire perimeters of panel frames.
    d. Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches (450 mm) wide by full height of unit casing up to a maximum height of 60 inches (1500 mm).

2. Doors:

    a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
    b. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
    c. Gasket: Neoprene, applied around entire perimeters of frame.
    d. Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches (450 mm) wide by full height of unit casing up to a maximum height of 60 inches (1500 mm).

3. Locations and Applications:

    a. Fan Section: Doors.
    b. Coil Section: Panels.
    c. Access Section: Doors.
    d. Access Sections Immediately Upstream and Downstream of Coil Sections: Doors.
    e. Damper Section: Doors.
    f. Filter Section: Doors large enough to allow periodic removal and installation of filters.
    g. Mixing Section: Doors.

F. Condensate Drain Pans:

1. Location: Each type of cooling coil.

2. Construction:

    a. Single-wall, stainless-steel sheet.

3. Drain Connection:

    a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
    b. Minimum Connection Size: NPS 1 (DN 25).

4. Slope: Minimum 0.125 in./ft. (10 mm/mm) slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers, and to direct water toward drain connection.
5. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
6. Width: Entire width of water producing device.
7. Depth: A minimum of 2 inches (50 mm) deep.

2.5 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

B. Fans: Centrifugal, rated according to AMCA 210; galvanized steel; mounted on solid-steel shaft.

1. Shafts: With field-adjustable alignment.

    a. Turned, ground, and polished hot-rolled steel with keyway.

2. Shaft Bearings:

    a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.

3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
5. Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel hub swaged to backplate and fastened to shaft with setscrews.
6. Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels): Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
7. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch (25 mm).
8. Shaft Lubrication Lines: Extended to a location outside the casing.
9. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches (89 mm) wide, attached to two strips of minimum 2-3/4-inch- (70-mm-) wide by 0.028-inch- (0.7-mm-) thick, galvanized-steel sheet.

a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.

C. Drive, Direct: Factory-mounted, direct drive.

D. Drive, Belt: Factory-mounted, V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.

1. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
2. Belts: Oil resistant, non-sparking and nonstatic; in matched sets for multiple-belt drives.
3. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.146-inch- (2.7-mm-) thick, 3/4-inch (20-mm) diamond-mesh wire screen, welded to steel angle frame; prime coated.

E. Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
3. Enclosure Type: Open, dripproof.
4. Enclosure Materials: Cast iron.
5. Efficiency: Premium efficient as defined in NEMA MG 1.
6. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
7. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

F. Motors:

G. Variable-Frequency Motor Controller: Comply with Section 262923 "Variable-Frequency Motor Controllers."

2.6 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with AHRI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.

B. Heating Coils:

1. Electrical Coils: Comply with UL 1995.

a. Casing Assembly: Flanged type with galvanized-steel frame.
b. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to

supporting brackets, and mounted in galvanized-steel frame.

c. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
d. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
e. Control Panel: Unit mounted with disconnecting means and overcurrent protection.

1) Magnetic contactor.
2) Solid-state, stepless pulse controller.
3) Toggle switches, one per step.
4) Step controller.
5) Time-delay relay.
6) Pilot lights, one per step.
7) Airflow proving switch.

2. Hot-Water Coils: Self-draining.

a. Piping Connections: Threaded, same end of coil.
b. Tube Material: Copper.
c. Fin Type: Plate.
d. Fin Material: Aluminum.
e. Fin Thickness: 0.0042 inches (0.10668 mm).
f. Fin and Tube Joint: Mechanical bond.
g. Headers:

1) Cast iron with cleaning plugs and drain and air vent tappings extended to exterior of unit.
2) Seamless copper tube with brazed joints, prime coated.
3) Fabricated steel, with brazed joints, prime coated.
4) Provide insulated cover to conceal exposed outside casings of headers.

h. Frames: Channel frame, minimum 0.052-inch- (1.3-mm-) thick galvanized steel.
i. Coil Working-Pressure Ratings: 200 psig (1380 kPa), 325 deg F (163 deg C).
j. Coating: None.

C. Cooling Coils:

1. Refrigerant Coil:

    a. Tubes: Copper.
    b. Fins:

        1) Material: Aluminum.

    c. Fin and Tube Joints: Mechanical bond.
    d. Headers: Seamless-copper headers with brazed connections.
    e. Frames: Galvanized steel.
    f. Coatings: Corrosion-resistant coating.
    g. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

        1) Working Pressure: Minimum 300 psig (2070 kPa).

2.7 AIR FILTRATION SECTION

A. Particulate air filtration is specified in Section 234100 "Particulate Air Filtration."

B. Panel Filters:

1. Description: Pleated factory-fabricated, self-supported disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
4. Filter-Media Frame: High wet-strength beverage board with perforated metal retainer, or metal grid, on outlet side.

C. Side-Access Filter Mounting Frames:

1. Particulate Air Filter Frames: Match inner casing and outer casing material, and insulation thickness. Galvanized steel track.

    a. Sealing: Incorporate positive-sealing device to ensure seal between gasketed material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

2.8 DAMPERS

A. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. (20 L/s per sq. m) at 1-inch wg (250 Pa) and 8 cfm/sq. ft. (40 L/s per sq. m) at 4-inch wg (1.0 MPa) rated in accordance with AMCA 500D).

B. Electronic Damper Operators:

1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
2. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
3. Operator Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
    c. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
6. Size dampers for running torque calculated as follows:

a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.
d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.

7. Coupling: V-bolt and V-shaped, toothed cradle.
8. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
9. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
10. Power Requirements (Two-Position Spring Return): 24 V dc.
11. Power Requirements (Modulating): Maximum 10 VA at 24 V ac or 8 W at 24 V dc.
12. Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
13. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
14. Run Time: 12 seconds open, 5 seconds closed.

C. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.

D. Combination Filter and Mixing Section:

1. Cabinet support members shall hold 2-inch- (50-mm-) thick, pleated, flat, permanent or throwaway filters.

2.9 AIR BLENDERS

A. Multiple-blade, air-mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.

2.10 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

2.11 SOURCE QUALITY CONTROL

A. AHRI 430 Certification: Air-handling units and their components shall be factory tested according to AHRI 430 and shall be listed and labeled by AHRI.

B. AMCA 300 and AMCA 301, or AHRI 260 Certification: Air-handling unit fan sound ratings shall comply with AMCA 300, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data" and AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data," or with AHRI 260, "Sound Rating of Ducted Air Moving and Conditioning Equipment."

C. Water Coils: Factory tested to 300 psig (2070 kPa) according to AHRI 410 and ASHRAE 33.

D. Refrigerant Coils: Factory tested to minimum 450-psig (3105-kPa) internal pressure, and to minimum 300-psig (2070-kPa) internal pressure while underwater, according to AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for hydronic and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install air-handling units on cast-in-place concrete equipment bases. Coordinate sizes and locations of concrete bases with actual equipment provided. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

C. 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.

D. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to air-handling unit, allow for service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4 (DN 32), ASTM B88, Type M (ASTM B88M, Type C) copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

F. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
7. Comb coil fins for parallel orientation.
8. Verify that proper thermal-overload protection is installed for electric coils.
9. Install new, clean filters.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.7 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling unit and air-distribution systems, and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
2. Charge refrigerant coils with refrigerant and test for leaks.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

E. Air-handling unit and components will be considered defective if unit or components do not pass tests and inspections.

F. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 23 73 13.13

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Hot water heating.
2. Economizer outdoor- and return-air damper section.
3. Integral, space temperature controls.

1.3 DEFINITIONS

A. DDC: Direct-digital control.

B. ECM: Electrically commutated motor.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. VVT: Variable-air volume and temperature.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

3. Wind- and Seismic-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 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. Structural members to which RTUs will be attached.

2. Roof openings

B. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Seismic Qualification Certification: Submit certification that RTUs, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports.

E. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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. Fan Belts: One set for each belt-driven fan.

2. Filters: One set of filters for each unit.

1.8 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. 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.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Carrier Corporation.
2. Daikin-McQuay
3. Trane
4. York International Corporation.

2.2 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.

1. Exterior Casing Thickness: 0.052 inch (1.3 mm) thick.

C. Inner Casing Fabrication Requirements:

1. Inside Casing: Galvanized steel, 0.034 inch (0.86 mm) thick.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.
2. Thickness: 1/2 inch (13 mm).
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of galvanized-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.1.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 FANS

A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

C. Relief-Air Fan: Forward curved, shaft mounted on permanently lubricated motor.

D. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

E. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

A. Hot-Gas Reheat Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
3. Cathodic epoxy coating.

2.5 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Glass Fiber: Minimum 80 percent arrestance, and MERV 8.
2. Pleated: Minimum 90 percent arrestance, and MERV 8.

2.6 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with manual damper filter.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.7 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.8 CONTROLS

A. Basic Unit Controls:

1. Control-voltage transformer.
2. Wall-mounted thermostat or sensor with the following features:
    a. Heat-off switch.
    b. Fan on-auto switch.
    c. Fan-speed switch.
    d. Automatic changeover.
    e. Adjustable deadband.
    f. Concealed set point.

g. Concealed indication.

h. Degree F indication.

i. Unoccupied-period-override push button.

j. Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.

B. DDC Controller:

1. Controller shall have volatile-memory backup.

2. Safety Control Operation:

a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.

b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg F (54 deg C) enters unit. Provide additional contacts for alarm interface to fire alarm control panel.

c. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F (4 deg C).

d. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.

3. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.

4. Unoccupied Period:

a. Heating Setback: 10 deg F (5.6 deg C).

b. Cooling Setback: System off.

c. Override Operation: Two hours.

5. Supply Fan Operation:

a. Occupied Periods: Run fan continuously.

b. Unoccupied Periods: Cycle fan to maintain setback temperature.

6. Refrigerant Circuit Operation:

a. Occupied Periods: Cycle or stage compressors, and operate hot-gas bypass to match compressor output to cooling load to maintain room temperature. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.

b. Unoccupied Periods: Cycle compressors and condenser fans for heating to maintain setback temperature.

7. Hot-Gas Reheat-Coil Operation:

a. Occupied Periods: Humidistat opens hot-gas valve to provide hot-gas reheat, and cycles compressor.

b. Unoccupied Periods: Reheat not required.

8. Fixed Minimum Outdoor-Air Damper Operation:

a. Occupied Periods: Open to 25 percent.

b. Unoccupied Periods: Close the outdoor-air damper.

9. Economizer Outdoor-Air Damper Operation:

   a. Occupied Periods: Open to 25 percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F (15 deg C). Use outdoor-air enthalpy to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.

   b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

   c. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature, and output shall range from 4 to 20 mA.

2.9 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required.

B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

2.10 CAPACITIES AND CHARACTERISTICS

A. As scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for AHUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where AHUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install AHUs on existing curbs. Modify as necessary with curb adaptors.

2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to AHUs to allow service and maintenance.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof opening.
2. Remove roof decking only as required for passage of ducts.
3. Connect supply ducts to AHUs with flexible duct connectors specified in Section 233113 "Metal Ducts."
4. Connect return-air duct to existing duct running continuously through roof structure.

3.4 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.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs 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.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. 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 compressor, coils, and fans.
3. Inspect internal insulation.

4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Clean condenser coil and inspect for construction debris.
9. Remove packing from vibration isolators.
10. Inspect operation of barometric relief dampers.
11. Verify lubrication on fan and motor bearings.
12. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
13. Adjust fan belts to proper alignment and tension.
14. 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.
15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Calibrate thermostats.
18. Adjust and inspect high-temperature limits.
19. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
20. Start hot water system and measure and record the following when ambient is a minimum of 15 deg F (8 deg C) 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.
21. Inspect controls for correct sequencing of mixing dampers, refrigeration, and normal and emergency shutdown.
22. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.
23. 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.
24. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

a. High-temperature limit on gas-fired heat exchanger.

b. Low-temperature safety operation.

c. Filter high-pressure differential alarm.

d. Economizer to minimum outdoor-air changeover.

e. Relief-air fan operation.

f. Smoke and firestat alarms.

25. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. 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.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Schedule training with Owner with at least seven days’ advance notice. Provide two training sessions of eight hours each.

END OF SECTION 237413

SECTION 238239.19 - WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details of anchorages and attachments to structure and to supported equipment.
4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
5. Wiring Diagrams: Power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CABINET

A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.

B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Owner, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.3 ELECTRIC UNIT HEATERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
1. Beacon Morris
2. Dayton
3. Reznor

B. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.4 HYDRONIC UNIT HEATERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
1. Beacon Morris
2. Dayton
3. Reznor

B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings: 200 psig (1380 kPa), 325 deg F (163 deg C).

D. Source Quality Control: Factory tested to 300 psig (2070 kPa).

E. Tubes: ASTM B743 copper, minimum 0.035 inch (0.889 mm) thick.

F. Fins: Copper, minimum 0.010 inch (0.254 mm) thick.

G. Headers: Seamless copper tube with brazed joints, prime coated.

H. Frames: Galvanized-steel channel frame, minimum 0.064 inch (1.6 mm) thick for flanged mounting.

I. Coating: Corrosion-resistant.
1. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.

a. Standards:

1) ASTM B117 for salt spray.
2) ASTM D2794 for minimum impact resistance of 100 in-lb (11.3 N-m).
3) ASTM B3359 for cross hatch adhesion of 5B.

b. Application: Immersion.
c. Thickness: 1 mil (0.025 mm).
d. Gloss: Minimum gloss of 60 on a 60-degree meter.

2.5 FAN AND MOTOR

A. Fan: Aluminum propeller directly connected to motor.

B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

A. Controls: Remote-mounted thermostat**.**

B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

2.7 CAPACITIES AND CHARACTERISTICS

A. As Scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall and ceiling unit heaters level and plumb.

C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

SECTION 260001- CONSTRUCTION ADMINISTRATION FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 GENERAL

A. This Section contains requirements for Construction Administration of Electrical work. These requirements are in addition to any requirements listed elsewhere in the Contract Documents. Where conflicts exist between this section and other sections, the more stringent requirement shall apply.

1.2 SECTION INCLUDES

A. Delegated Design

B. Substitution Procedures

C. Payment Procedures
   1. Schedule of Values

D. Project Management and Coordination
   1. Service Interruption Schedule
   2. Coordination Drawings
   3. Requests for Information (RFIs)

E. Submittal Procedures
   1. Submission Schedule
   2. Shop Drawings

F. Project Requirements
   1. Equipment Manufacturer List

G. Project Record Documents
   1. As-Built Drawings

H. Closeout Procedures
   1. Substantial Completion
   2. Punchlist Completion

I. Operations & Maintenance Data
   1. Operation and Maintenance Manuals

J. Electronic Documentation Exchange

1.3 RELATED REQUIREMENTS

A. Section 012500 ”Substitution Procedures” for requests for substitutions.

B. Section 012900 “Payment Procedures” for additional details on schedule of values and applications for payment.

C. Section 013100 ”Project Management and Coordination” for additional details on general project coordination, coordination drawings, and RFIs.

D. Section 013300 “Submittal Procedures” for additional details on submittal process

E. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

F. Section 017700 “Closeout Procedures” for additional details on record documents

G. Section 017823 "Operation and Maintenance Data"

H. Section 017839 “Project Record Documents”

1.4 DELEGATED DESIGN

A. Definition

1. Materials, components, details, fabrications, systems, calculations or assemblies designed by a licensed engineer engaged by an entity other than the project Engineer of Record. Entities can include (but not be limited to), contractors, subcontractors, suppliers, vendors or fabricators.

B. Design Criteria

1. Basis of design, descriptions or related performance criteria for materials, components, details, fabrications, systems, calculations or assemblies shall be as provided in the contract documents.

C. Delivery

1. Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional.

D. Responsibilities

1. The Contractor shall obtain and pay for the services of a Professional Engineer, with at least 10 years of design experience, licensed to practice in the state in which this project is being constructed. This Professional Engineer shall be responsible for design, documentation, review, submittal documents and implementation elements related to the Delegated Design noted in the contract documents. Delegated Design Professional Engineer shall be designated the Engineer of Record for the scopes of work related to the Delegated Design.

1.5 SUBSTITUTION PROCEDURES

A. Definitions

1. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

2. 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.

3. 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

B. Submission

1. Substitution Requests: Use CSI form 1.5C or equivalent form acceptable to Architect or Engineer.

2. Substitutions for specified equipment must include a detailed comparison checklist identifying all pertinent similarities and differences between the items in question.

3. 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. Research reports evidencing compliance with building code in effect for Project, from applicable codes.

j. 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.

k. Cost information, including a proposal of change, if any, in the Contract Sum.

l. 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.

m. 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.

4. Substituted items without a comparison will not be considered.

5. Where substituted items affect other trades, this Contractor is fully responsible for adjusting the installation as required to accommodate the substitution. This includes, but is not limited to, changes in Architectural, Structural, Mechanical, Electrical, Plumbing and Fire Protection Systems. This Contractor will assume and pay for all associated costs and related impacts.

6. Should substitution provided by the Contractor require changes in design which necessitate Professional Services (architecture, engineering, subconsultants, vendors or related providers) the Contractor shall assume and pay for all related Professional Services costs.

7. Incomplete submittals will be returned as Rejected.

C. 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.

B. Substitutions

1. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than **15 working days** prior to time required for preparation and review of related submittals.

a. Conditions: Architect or Engineer 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:

1) Revise conditions in subparagraphs below. If required, insert more restrictive conditions to limit consideration of proposed substitutions.

2) Requested substitution is consistent with the Contract Documents and will produce indicated results.

3) Substitution request is fully documented and properly submitted.

4) Requested substitution will not adversely affect Contractor's construction schedule.

5) Requested substitution has received necessary approvals of authorities having jurisdiction.

6) Requested substitution is compatible with other portions of the Work.

7) Requested substitution has been coordinated with other portions of the Work.

8) Requested substitution provides specified warranty.

9) 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.

2. Substitutions for Convenience: Not allowed unless otherwise indicated.

3. 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. Revise conditions in subparagraphs below. If required, insert more restrictive conditions to limit consideration of proposed substitutions.

b. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

c. Requested substitution does not require extensive revisions to the Contract Documents.

d. Requested substitution is consistent with the Contract Documents and will produce indicated results.

e. Substitution request is fully documented and properly submitted.

f. Requested substitution will not adversely affect Contractor's construction schedule.

g. Requested substitution has received necessary approvals of authorities having jurisdiction.

h. Requested substitution is compatible with other portions of the Work.

i. Requested substitution has been coordinated with other portions of the Work.

j. Requested substitution provides specified warranty.

k. 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.

1.6 PAYMENT PROCEDURES

A. Schedule of Values

1. Prior to initiating any work, the Contractor shall submit a Schedule of Values on an AIA G-703 Continuation Sheet outlining Material and Labor costs for each item.

2. Include in the Schedule of Values a line item for resolving Punchlist issues equal to 5% of the total contract value.

3. No Payment Applications will be processed until the Schedule of Values form has been approved by the Engineer.

1.7 PROJECT MANAGEMENT AND COORDINATION

A. Service Interruption Schedule

1. Within ten (10) business days of the contract award date, the Contractor shall submit a Schedule of Shutdowns of equipment and/or systems for Owner and Engineer review.

2. The Contractor shall notify the Owner and Engineer in writing at least five (5) business days prior to each equipment and/or system shutdown.

B. Coordination Drawings

1. Definition:

a. Contractor-prepared drawings submitted by Contractor to Owner to demonstrate: (1) The coordination of methods, materials, equipment, systems, plans, or sequence the Contractor proposes to use for installation of different components within the architectural, structural, civil and environmental envelope; (2) The coordination required for installation of Products and materials Fabricated by separate entities; and (3) The relationship of components shown on separate Shop Drawings or Submittals, when coordination among these components is required.

2. Contract Documents

a. Contract drawings are diagrammatic in nature with respect to mechanical, electrical, plumbing, fire protection, specialty systems (medical/industrial gasses, compressed air, etc.), and related low voltage (life safety and non-life safety) systems. Not every bend, offset and direction change is shown in the Contract Documents. The Contract Documents represent that these systems will fit in the spaces allotted; however, it is the responsibility of the Contractor to assign space priorities, lay out and route the systems so they will fit efficiently in the allotted spaces and allow for convenient and code-conforming access and maintenance space to all valves, dampers, filters, panels and other devices.

b. Layout of utility, HVAC equipment and electrical rooms, is diagrammatic in nature. The Contract Documents represent that equipment identified to be installed in these rooms will fit in the spaces allotted. However, because the Contractor must submit and provide for equipment to be installed in these rooms, it is the Contractor’s responsibility to lay-out the equipment room such that all equipment will fit.

c. The Contractor must examine all the Contract drawings, especially architectural for ceiling space dimensions, and structural for beam/column obstructions, and make allowances in the Contractor’s planned coordination efforts, work sequence, and routing of the systems.

d. Routing shown for pipes, ducts, and conduits on Drawings are shown by graphic symbols only; make runs parallel with lines of building.

e. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

f. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated; coordinate locations of fixtures and outlets with finish elements.

g. Size ductwork, mechanical pipe, plumbing, electrical, and sprinkler system components as shown in the Contract Documents and Drawings. Downsizing of Mechanical/Electrical/Plumbing/Fire Protection (M/E/P/FP) systems is not permitted.

3. Coordination Drawing Development

a. Contractor shall prepare, and submit for acceptance, Coordination Drawings as a submittal/shop drawing prior to equipment or system installation. Contractor shall prepare Coordination Drawings in order to resolve potential installation and constructability problems prior to installation so that construction cost and schedule are not impacted.

b. Coordination Drawings shall include dates and signatures of the Contractor and all Subcontractors whose work occurs in the space; signed Coordination Drawings shall be subject to examination by the Owner at any time.

c. Contractor shall require Subcontractors to develop Subcontractor Coordination Plans of the same scale as Contractor's Coordination Drawings to assist in making transcripts for transfer to Coordination Drawings; use approved Shop Drawings for Coordination Drawings.

d. Contractor shall require Subcontractors to develop Subcontractor Coordination Plans of the same scale as Contractor's Coordination Drawings to assist in making transcripts for transfer to Coordination Drawings; use approved Shop Drawings for Coordination Drawings.

e. Coordination drawings will be developed, at a minimum, as editable AutoCAD drawings with separate layers for each system or trade. Contractor shall make drawings available for Owner review upon request.

f. Coordination drawings shall be used as the baseline for development and submission of As-Built drawings by the Contractor.

4. Coordination Drawing Elements To Be Clearly Shown

a. Layout and routing of mechanical, electrical, plumbing, fire protection and related low voltage (life safety and non-life safety) systems in above-ceiling spaces, utility chases, raised flooring (if applicable), other interstitial spaces, and underground ducts. Elements to include in Coordination Drawings include:

1) Mechanical ducts and pipes, including floor penetrations;

2) Plumbing pipes, including supply and gravity drain lines;

3) Fire protection branch lines and sprinkler heads;

4) Electrical panels, conduit, bus ducts;

5) Voice/data cable trays and conduits;

6) Interstitial space access;

7) Identification and resolution of interfering structural elements: beams, columns, slabs, hangers, bracing, etc. and mechanical/electrical systems;

8) Identification and resolution of conflicts with mechanical/electrical systems and fire-rated walls;

9) Identification and resolution of conflicts between mechanical and electrical systems and suspended ceilings and light fixtures;

10) Identification and resolution of conflicts between mechanical and electrical systems and insulation;

11) Security system elements;

12) The relationship of components that are shown on separate Shop Drawings or Submittals.

13) Seismic restraints where required on systems.

14) All Work above ceilings performed by separate entities that must interface or for which space provided is limited; and

15) Others as necessary.

b. Actual physical relationships of the various elements and systems and their interfacing with other elements and systems. The Drawings use graphic symbols to show certain physical relationships. Establishing and coordinating the actual physical relationships is the responsibility of the Contractor. Layout and arrange all elements to contribute to safety and efficiency while maintaining the intent of the design. Before work proceeds in areas of potential conflict for installing different components of the work, Contractor shall prepare Coordination drawings for review and acceptance by the Owner, that clearly demonstrate resolution of any conflicts.

c. Dimensions and elevations where conflicts may exist. Final Coordination drawings shall show resolution of any potential field conflicts.

d. Location, for maintenance and repair purposes, of all above-ceiling valves, fire dampers, control devices, meters and gauges, and heating coils, and the access hatches (in “hard lid) ceilings that provide a means of access to these devices. These devices and appurtenances must be located such that a workman has unimpeded access to perform maintenance, repair or replacement. "Unimpeded access" means that a workman can access the device from a location immediately below the device, via the removal of a lay-in ceiling tile, or an access door/panel. All above-ceiling valves, fire dampers, control devices and heating coils shall be located such that there are no interferences from systems furniture, or above-ceiling mechanical or electrical systems. The Coordination drawings must clearly represent this accessibility.

e. How equipment, controls, valves, power panels and disconnects will fit in ceilings, equipment room(s) space, and still comply with code, and manufacturer’s maintenance requirements, with respect to clearance.

f. Maintenance of fire-rating of so-designated walls. Contractor shall review the architectural drawings for the location of fire-rated walls, and ensure that the placement of ducts, pipes or other systems do not compromise the fire-rating of walls. If ducts do penetrate fire-rated walls, the coordination drawings must show such penetrations, and shall indicate the placement of required Fire-smoke dampers. If the fire rating of designated walls cannot be maintained due to pipe or duct penetrations, as part of the Coordination Drawing process, the Contractor shall immediately bring these situations to the attention of the Owner.

5. Contractor Coordination Drawing Responsibilities

   a. Oversee preparation of Coordination Drawings, as required by this Section.

   b. Assign space priorities

   c. Notify Owner in writing of unresolved conflicts or interferences found during preparation of Coordination Drawings.

C. Requests for Information

1. Requests for Information (RFI) are questions posed by the Contractor intended to resolve vagueness and conflicts during bidding or construction.

2. To submit a RFI, the Contractor must utilize one of the following approaches:

   a. Complete an AIA G716 Request For Information form or equal as approved by Architect or Engineer. Where prior approval by Architect or Engineer has been obtained, RFI may be submitted electronically via email using a common Subject Line format. An electronically submitted RFI must include all information found on AIA form

      1) Subject Line (Example): Project Name – Trade (MEP or FP) RFI #XXXX

      2) All RFI requests must be copied electronically to the architect (where applicable).

   b. Where implemented by Architect or Engineer, RFI may be submitted via web-based project management software platform using pre-defined forms.

3. Independent of the RFI submission format used, all fields must be fully complete and submitted with a proposed solution, response, selection or approach. Incomplete RFIs or those submitted without a proposed solution will be returned unchecked.

4. Where possible, all RFI should be accompanied with pictures, tables, graphs, sketches or supplementary explanatory material. This procedure allows the responder to have as much information as practical at the time of review for timely and accurate responses.

5. Quality Control & Certification

   a. Prior to submitting a RFI, the Contractor must thoroughly review the Construction Documents and Specifications and forward the RFI only if the issue in question cannot be resolved. If an RFI questions a clearly noted item or standard construction method which should be known by the Contractor, the Engineer may back charge the Contractor for time spent responding to the RFI.

   b. Certification Statement: I certify that I have thoroughly reviewed the Documents and am unable to reconcile this issue. I acknowledge that if the issue is easily reconcilable by reviewing the Documents or is asking direction on standard construction methods that should be known by the Contractor, the Professionals can back charge the Requestor for the effort involved in the review and response.

1.8 SUBMITTAL PROCEDURES

A. Submission Schedule

1. Prior to submitting any Shop Drawings, the Contractor shall issue a Shop Drawing Submission Schedule. The purpose of this schedule is to identify which items require Shop Drawings and when these Shop Drawings will be submitted to the Engineer. By agreeing to this schedule at the beginning of the project, Shop Drawings will be reviewed in a timely fashion and long lead items can be prioritized.
2. The Contractor shall list all the items that require submittals per the Contract Documents and Specifications. At a minimum, the submittal schedule must include the following columns associated with each submitted:
    a. Specification Section Reference Number
    b. Specification Section Title
    c. Submittal ID Number
    d. Product, Material or System Description
    e. Schedule Information
        1) Submittal Submission Date
        2) Anticipated Return Date (best guess)
        3) Long Lead Item (Y / N)
        4) Expedited Review Required (Y / N)
3. Contractor shall provide complete information for each column heading for each item and return the completed document to the Engineer for review. The Contractor may use spreadsheets or web-based project management software platform provided all required information is provided.
4. No Shop Drawings will be reviewed until the Shop Drawing Submission Schedule is approved by the Engineer.

B. Shop Drawings

1. Shop Drawings will not be reviewed until the Equipment Manufacturer List and Shop Drawing Submission Schedule have been submitted to, and approved by, the Engineer.
2. Engineer shall review and return submittals within ten (10) business days of receipt. Expedited review of submittals may occur, however such review must be approved by the Engineer prior submission and be noted in the Shop Drawing Submission Schedule. Note that Contractor may only identify a limited number of submittals as requiring Expedite Review.
3. Shop Drawings must include a completed copy of the Shop Drawing Transmittal
    a. Contractor must review and stamp all Shop Drawings prior to submission. Stamp shall appear on each contractor transmittal for individual shop drawings. Submittals without the Contractor's stamp will be returned unchecked.
    b. Contractor stamp must include a general affidavit of the following:
        1) Contractor “X” has reviewed the shop drawings, product data, samples and other submittals that related to this submission. All dimension, quantities, field dimensions existing work interface with other trades and conditions have been verified. These submittals are approved to the extent approval is required by the Contract Documents.

4. Contractor shall submit PDF version of submittal, with transmittal / cover sheet, to the Engineer for review.
    a. Submitted items shall be clearly identified on all copies of the Shop Drawings. The Engineer will return any Shop Drawings that are not clearly marked.
5. It is the responsibility of the Contractor to make every attempt to ensure thoroughness and accuracy of his submittals. If Shop Drawings are not approved following a maximum of two (2) reviews, the Contractor will be back-charged for the Engineer's effort.
6. Submittals shall be segregated as individual elements to for timely review and to ensure rejection of one item does not unduly delay other items within the same submittal. Submittals encompassing both equipment and materials (e.g.: pumps and piping) will be returned to the Contractor unchecked.

1.9 PRODUCT REQUIREMENTS

A. Equipment Manufacturer List
1. Within ten (10) business days of the contract award date, the Contractor shall submit a list of equipment manufacturers, for the engineer's review and approval, that he intends to use on this project.

1.10 PROJECT RECORD DOCUMENTS

A. As-Built drawings
1. Contractor to maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings onsite. Review As-built Drawings and shop drawings monthly with the Owner, for approval.
    a. Preparation: Daily mark As-built Drawings 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 As-built Drawings.
        1) Document with specificity concealed elements that would be difficult to identify or measure and record later.
        2) Accurately record information in an acceptable drawing technique.
        3) Record data as soon as possible after obtaining it.
        4) Record and check the markup before enclosing concealed installations.
    b. Content: Types of items requiring marking include, but are not limited to, the following:
        1) Dimensional changes to drawings.
        2) Revisions to details shown on drawings.
        3) Depths of foundations below first floor.
        4) Locations, routing and depths (invert elevations) of underground utilities.

5) Revisions to routing of piping and conduits.

6) Revisions to electrical circuitry and lighting.

7) Revisions to low voltage systems (both life safety and non-life safety).

8) Actual equipment locations.

9) Duct and piping sizes and routing.

10) Locations of concealed internal utilities.

11) Changes made by Change Order or Change Directive.

12) Changes made following the Owner's written orders.

13) Details not on the original Contract Drawings.

14) Field records for variable and concealed conditions.

15) Record information on the Work that is shown only schematically.

c. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up as-built prints.

d. Mark as-built sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

e. Mark important additional information that was either shown schematically or omitted from original drawings.

f. Mark all changes requested by Owner, Architect or Engineer.

g. Note Construction Change Directive numbers, Alternate numbers, Change Order numbers, and similar identification, where applicable.

2. Deliverable

a. As-built drawings will be separated by trade in a manner consistent with the Contract Documents.

b. As-built documents shall be available for review by Owner, Architect or Engineer at the end of each week.

1.11 CLOSEOUT PROCEDURES

A. Substantial Completion

1. The purpose of this document is to inform the Architect or Engineer that the Contractor has reached Substantial Completion.

2. Contractor shall complete AIA G704 or equal as approved by Architect or Engineer. Additionally, a letter on company letterhead shall attesting to the following:

a. Be advised that [Contractor Name] has reached Substantial Completion for the above-mentioned project. We understand that DLB Associates should receive this letter at least four (4) weeks prior to the project completion date. We are prepared for the Punchlist review and assure that any items found to be incomplete will be fixed within two (2) weeks of receiving the Punchlist.

3. The AIA document and letter shall be received at the Architect's or Engineer's office no later than four (4) weeks before the project completion date. Upon receiving the letter, the Engineer will perform a Punch List. The Contractor shall have two (2) weeks to complete the Punch List items upon receiving the Punch List.

B. Punchlist Completion

1. The purpose of this letter is to inform the Architect or Engineer that the Contractor has completed all Punchlist items. The Contractor must ensure that all Punchlist items are indeed complete prior to submitting this letter.

2. Upon Punchlist Completion, the Contractor shall copy the Punchlist Completion Letter onto company letterhead, complete the letter and send it to the Architect or Engineer. Additionally, a letter on company letterhead shall attesting to the following:

a. Be advised that we have completed all Punchlist items for the above-mentioned project and consider the construction to be 100% complete. We understand that DLB Associates should receive this letter at least one (1) week prior to the project completion date. We are prepared for the final walk through and review.

3. This letter shall be received at the Engineer's office no later than One (1) week before the project completion date. Upon receiving this letter, the Engineer will perform a final walkthrough. Should the Engineer discover during the final walkthrough that not all Punchlist items have not been completed, the time and expenses associated with a return visit by the Engineer shall be chargeable to the Contractor.

1.12 OPERATION AND MAINTENANCE DATA

A. Operation and Maintenance Manuals

1. Furnish three copies of complete operations and maintenance manuals to the architect-engineer for approval prior to delivery to the owner, on all equipment and systems.

a. Manuals shall be printed on 8-1/2" x 11" paper and bound in three ring binders with clear covers.

b. Electronic Copies May Be Submitted In Place Of Physical Submissions If Permission Is Granted By Architect And Engineer.

2. The following shall be included:

a. Title sheet with job name, and the names, addresses and phone numbers of the contractor, subcontractor, control subcontractor, related contractors, material and equipment suppliers. the equipment model numbers and serial numbers shall be listed.

b. A comprehensive table of contents for all sections.

c. Printed operating instructions for the owner's personnel describing how to operate (start, stop, and perform normal and emergency operating procedures) each piece of equipment, how to set the temperature control system for normal operation and normal restarting procedures, and caution / warning notices.

d. A copy of acknowledgment of instruction to the owner's operating personnel in the operation of all equipment and systems, signed by the owner or his authorized representative.

e. Approved shop drawings, product data, and parts and maintenance booklet for each item of material and equipment furnished under this contract.

f. Test and balance reports.

g. Copies of certificates of inspection and warranties, including extended warranties (where applicable).

3. Deliver the manuals to the owner prior to submitting application for final payment.

1.13 PROJECT RECORD DOCUMENTS

A. Record Drawings

1. The contractor shall prepare a complete set of record drawings of all systems including electrical and control diagrams prior to final payment. Final payment shall not be made until the record drawings are deemed complete for all trades and approved by the Engineer.

2. The drawings shall be drafted by a professional draftsman using AutoCAD (DWG format) with discreet file and layer as described in the AIA CAD Layer Guidelines or similar convention. Other software or layer naming conventions will be approved only in writing by owner and architect/engineer.

3. Record drawings shall clearly indicate the installed conditions of the MEP/FP work as noted in the As-Built drawings for all trades. Contractor shall provide owner with:

a. Digital storage media containing editable, vector-based, electronic AutoCAD files with required blocks, XREFs, linetypes and styles.

b. One (1) full size and two (2) half size prints, bound.

c. PDF of above listed items on digital storage media for owner records.

4. Upon completion and acceptance of work, contractor shall furnish type-written updated panel schedules for any panel in which work was done. Provide a hard copy and electronic copy to the owner.

1.14 ELECTRONIC DOCUMENTATION EXCHANGE

A. Request for Computer Generated Design Documentation

1. Upon written request using the following form and subject to the approval of the Owner, DLB will furnish contractor with computer generated (AutoCAD or BIM/Revit) design document data subject to the qualifications and limitations identified on the request form.

Attn: Name (email)
(DLB Project Manager/Construction Manager Name)

DLB Associates Consulting Engineers, P.C.
3600 Route 66, Suite 150 - #5981, Neptune, NJ 07753
(732) 774-2000
Re: Electronic Document Exchange Agreement

Name
(Project Name)
Address
(Project Address)
#######
(DLB Project Number)

Computer generated (AutoCAD or BIM/Revit) design document data is provided at the request of, and for the convenience of the Recipient only. Data has been prepared as a DLB Associates (DLB) internal working document and as such, may be incomplete or contain unintentional accuracies. Additionally, subsequent revisions to actual infrastructure locations after these documents were created may not be reflected in the data files. DLB makes no warranties, either express or implied, as to the accuracy of the data provided. The user is warned that while all digital data appears to be extremely accurate, this apparent accuracy is an artifact of the techniques used in its creation and should in no way imply actual accuracy. Recipient of this data takes full responsibility for the accuracy and correctness of all measurements, areas, elevations, inventories, and related information extracted from files either manually or with the use of a computer.

DLB employs an automated system of complex files links and customized drawing elements to create contract documents. As a result, DLB is unable to simply copy files for distribution. DLB must edit the individual files to create a format which is compatible for outside users. Without these steps, files would be nearly unusable and ultimately take longer for Recipients to adapt versus starting from scratch.

DLB office policy is to charge for electronic document preparation so the Recipient can make use of the data. Charges are based on currently published hourly labor rates. NOTE: Floor plans will be made available for the Recipient. Specifications, spreadsheets, native engineering calculation files, details, general notes, title blocks, diagrams, risers, etc. will not be provided.

Recipient is advised that any translation of data from one computer system or environment to another can result in the loss of important data. Losses can include but are not limited to portions of text and dimensions, the existence, location or scale of symbols or other graphical elements and the internal structure of the data (including layers, data attributes, styles or line weights.) DLB makes no representation as to usability of the data on any outside system.

Recipient confirms, by acceptance and use of data provided, the above conditions, and agrees to the fullest extent of the law, to indemnify and hold DLB harmless from any damage, liability or cost, including but not limited to reasonable attorney's fees and cost of defense, arising from such use, or from any changes made by these files by anyone other than DLB, or from any reuse from the files and data without the prior written consent of DLB.

(Company Name)

(Authorized Signature)

(Printed Name & Date)

PART 2 - PRODUCTS - Not Used.

PART 3 - EXECUTION - Not Used.

END OF SECTION 230001

SECTION 260500– GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. All products shall be UL listed and labeled and shall comply with NFPA 70.

1.2 DEMOLITION AND REMOVALS

A. Disconnect, remove and / or relocate existing material, equipment and other work as noted or required for proper installation of new work.

B. Except where existing wiring is indicated to be re-used, any item indicated for removal shall be removed, inclusive of any raceway, boxes, wiring, etc., back to its originating source.

C. All existing material, equipment and construction debris to be removed under this contract shall become the property of the Contractor. Removed equipment shall be properly disposed of by the Contractor.

D. Connections to existing work: Install new work and connect to existing work with minimum interference to existing facilities.

E. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work. Connect new work to existing work in a neat and workmanlike manner. Restore existing disturbed work to original condition, including maintaining wiring continuity as required.

F. Restore all existing surfaces to match surrounding surface.

1.3 OPERATIONAL TESTING

A. Perform operational testing of all new equipment until equipment runs trouble-free for 30 consecutive days.

B. Make final connections and perform startup of equipment for complete and operational systems upon completion.

1.4 CONSTRUCTION SEQUENCE, SCHEDULE, AND LIMITATIONS ON DOWNTIME

A. Contractor shall develop and submit a detailed construction sequence and schedule for the work.

1. All shutdown periods and temporary power facilities shall be described in detail.

B. Work will be conducted in a live working environment. Provide two week look ahead schedule to Owner throughout the project. Coordinate and obtain approval from Owner for any work that will affect live portions of the working environment prior to starting work.

C. Notify NJDWSC 5 days in advance of any proposed shutdowns. Coordinate details of proposed shutdowns with NJDWSC.

1. NJDWSC shall grant permission for shutdowns at its own discretion.

2. NJDWSC may delay or postpone scheduled shutdowns at any time as may be required to maintain operations.

D. Furnish floor wide fire watch during any fire alarm, or fire protection (sprinkler service) interruptions.

1.5 TEMPORARY POWER

A. Contractor shall make all arrangements and provide all equipment necessary to provide temporary power as required to complete the work.

1.6 CONFLICTS AND PROBLEMS

A. The Engineer and Owner shall be notified immediately upon discovery of a problem or conflict. Contractor shall promptly identify one or more proposed solutions but shall not proceed until so authorized.

1.7 COORDINATION

A. Coordinate the location and orientations of all equipment.

B. Contractor shall thoroughly familiarize himself and coordinate with existing conditions.

1.8 SUBMITTALS

A. Submittals (shop drawings) shall be provided for each piece of purchased equipment. Ensure thoroughness and accuracy of the submittals. The Contractor shall provide a stamp on the shop drawings stating that they conform to the drawings and specifications.

1. Long lead items shall be ordered promptly to ensure timely deliveries.

1.9 RECORD DRAWINGS

A. Prepare a complete set of Record Drawings of all systems including mechanical, electrical and control diagrams.

B. Record drawings shall clearly indicate the installed condition of the work including equipment locations and exact routing of all wiring, piping, and ductwork.

C. Provide updated panel schedules for all panelboards.

D. Record drawings shall include at a minimum 3 sets of printed drawings as well as electronic files.

E. Electronic drawing files shall be submitted in AutoCAD. Other electronic files shall be MS Word or Excel when possible.

1.10 INSPECTIONS AND PERMITS

A. Contractor shall arrange and pay for all permits, certificates, inspections, etc. And pay all fees levied by state, local and municipal authorities having jurisdiction over work done under this contract.

1.11 INSTALLATION

A. Drawings are diagrammatic and indicate general arrangement of systems and work. Drawings do not necessarily indicate the actual location of equipment, or routing including all offsets, drops, rises, and runs for conduit, piping, ductwork, etc.

B. "Furnish and install" or "provide" means to supply, erect, install and connect up to, complete for readiness for regular operation, the particular work referred to.

C. The Contractor shall furnish and install all supports, hangers, boxes, conduit, wiring and panels as required, and shall perform demolition and modification work as required, to make a complete and operable system.

D. Proper fire protection measures, satisfactory to the local fire department, shall be taken when welding or cutting with torches or electric arc. Contractor to provide open flame permit if required.

E. All work shall be done in a neat workmanlike manner, left clean and free from defects, and completely operable.

F. Install work so as to be readily accessible for operation, maintenance and repair.

1.12 DELIVERY AND HANDLING

A. Investigate each space through which equipment must be moved. Where necessary, equipment shall be shipped from manufacturer in sections of size suitable for moving through available restrictive spaces. Ascertain from owner at what times of day equipment may be moved through all areas.

B. Protect all equipment from the weather and damage at all times during shipment, storage and construction.

1.13 CUTTING AND PATCHING

A. Contractor shall perform all cutting and patching as required for his work. Do not cut building structural elements. Patch and paint to match adjacent surfaces.

B. All holes in masonry floors and walls shall be core drilled. Any core drilling shall be coordinated with the Owner.

C. All penetrations of floors (whether or not fire resistance rated) and all penetrations of fire rated walls and floors shall be provided with a through penetration protection system (firestopping). Each through-penetration protection system shall be tested in accordance with ASTM E814 and be listed for the type of floor or wall assembly penetrated and the type of protection system required.

1.14 WARRANTY

A. Basic warranty period shall be one year and shall start from the date of successful commissioning and start-up. A special warranty may also be required for certain equipment, as required in the individual specification sections for the equipment.

1.15 OPERATION AND MAINTENANCE MANUALS

A. At the completion of the project, provide the Owner with copies of installation, operation and maintenance procedures along with final approved shop drawings for each piece of equipment.

1.16 OPERATOR TRAINING

A. Provide comprehensive training for Owner's personnel covering the operation and maintenance of each piece of equipment provided on the project.

B. Training shall be conducted at the Owner's facility by a representative of the equipment manufacturer.

C. Submit a list of training topics and training schedule.

D. Document each training session and include training documentation in the Operation and Maintenance Manual.

END OF SECTION 200500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Control and signal wire.
3. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Southwire Incorporated.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: 600V, Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2 and Type XHHW-2.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.

6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. All wire shall be stranded.

B. Branch Circuits: Copper. Stranded for #8 and larger. Solid for #10 and smaller.

C. Control Wiring: Copper. All wire shall be stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway

B. Exposed Feeders: Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

D. Exposed Branch Circuits, Type XHHW-2, single conductors in raceway.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

F. Control Wiring: Type XHHW-2, single conductors in raceway, #14 AWG.

G. Signal Wiring (4-20mA): Shielded twisted pair, #18 AWG tinned copper, single pair, pair colors shall be black and red.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test all conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.

   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Category 6 balanced twisted pair cable.
2. Twin-axial data highway cable.
3. RS-232 cabling.
4. RS-485 cabling.
5. Low-voltage control cabling.
6. Control-circuit conductors.
7. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

D. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inches (1520 mm) or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

E. RoHS compliant.

2.2 CATEGORY 6 BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. CommScope, Inc.
3. General Cable; General Cable Corporation.
4. Mohawk; a division of Belden Networking, Inc.

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP) .

F. Cable Rating: Plenum (suitable for installation in any space).

G. Jacket: Blue thermoplastic.

2.3 TWIN-AXIAL DATA HIGHWAY CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, pairs, No. 24 AWG, stranded (7x32) tinned-copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, pairs, No. 24 AWG, stranded (7x32) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.4 RS-232 CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. Belden Inc.
3. General Cable Technologies Corporation.
4. Genesis Cable Products; Honeywell International, Inc.
5. Southwire Company.

B. PVC-Jacketed, TIA 232-F:

1. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. PVC jacket.
5. Conductors are cabled on common axis with No. 22 AWG, stranded (7x30) tinned copper drain wire.
6. NFPA 70 Type: Type CM.
7. Flame Resistance: Comply with UL 1581.

C. Plenum-Type, TIA 232-F:

1. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PE insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. Fluorinated ethylene propylene jacket.

5. Conductors are cabled on common axis with No. 22 AWG, stranded (7x30) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.5 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CMG.

1. Paired, one pair, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, one pair, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.6 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.7 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Encore Wire Corporation.
2. General Cable; General Cable Corporation.
3. Service Wire Co.
4. Southwire Company.

B. Class 1 Control Circuits: Stranded copper, Type XHHW-2, complying with UL 44 in raceway.

C. Class 2 Control Circuits: Stranded copper, Type XHHW-2, complying with UL 44 in raceway.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type XHHW-2, complying with UL 44 in raceway.

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.8 SOURCE QUALITY CONTROL

A. Factory test twisted pair cables according to TIA-568-C.2.

B. Cable will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
2. Flexible metal conduit shall not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Do not untwist balanced twisted pair cables more than 1/2 inch (12 mm) at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.
3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than **30 inches (760 mm** apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of **72 inches (1830 mm** of cable in a coil not less than **12 inches (305 mm**in diameter.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches (305 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

A. Comply with TIA-569-D, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526- GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Grounding arrangements and connections for separately derived systems.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.
8. O-Z/Gedney; A Brand of the EGS Electrical Group.
9. Robbins Lightning, Inc.

10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Stranded Conductors: ASTM B 8.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: All wire shall be stranded.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. When indicated on the drawings, install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, perform grounding system inspection and tests per NETA ATS 2013 section 7.13.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Section 2560548.16 – Seismic Controls for Electrical Systems.

1.2 DEFINITIONS

A. RMC: Rigid metal conduit.

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Steel slotted channel systems. Include Product Data for components.
2. Equipment supports.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Provide anchor-bolt inserts into bases.

B. Coordinate installation of, equipment supports.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.

c. ERICO International Corporation.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut; Atkore International.

g. Wesanco, Inc.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti, Inc.

2) ITW Ramset/Red Head; Illinois Tool Works, Inc.

3) MKT Fastening, LLC.

4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.

      2) Empire Tool and Manufacturing Co., Inc.

      3) Hilti, Inc.

      4) ITW Ramset/Red Head; Illinois Tool Works, Inc.

      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 CONCRETE BASES

A. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533- RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Metal wireways and auxiliary gutters.
3. Boxes.

1.2 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.3 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney.
6. Picoma Industries.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. EMT: Electrical Metallic Tubing with steel set screw fittings

E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

G. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Mono-Systems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type as indicated on drawings and sized according to NFPA 70.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman.
7. Hubbell Incorporated.
8. Kraloy.
9. Milbank Manufacturing Co.

10. Mono-Systems, Inc.
11. O-Z/Gedney.
12. RACO; Hubbell.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Device Box Dimensions: 4 inches square by 2-1/8 inches deep and 4 inches by 2-1/8 inches by 2-1/8 inches deep as required.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION – Refer to drawings for wiring methods.

A. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
3. EMT Conduit: Use steel set screw fittings.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Support conduit within 12 inches of enclosures to which attached.

G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

I. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

J. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

K. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

L. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

N. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. Install raceway sealing fittings according to NFPA 70.

O. Raceway Seal. Where a raceway enters a building or structure from outside, it shall be sealed. Spare or unused raceways shall also be sealed. Sealants shall be identified for use with cable insulation, conductor insulation, bare conductor, shield, or other components.

P. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as building exterior to building interior, and boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

Q. Mount boxes at heights indicated on Drawings.

R. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

S. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.
    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
3. Seismic-Restraint Details:
    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values

of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Refer to drawings for Seismic Design Criteria.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a Division of Cooper Industries.

2. Hilti, Inc.

3. Mason Industries, Inc.

4. Unistrut; Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kinetics Noise Control, Inc.

2. Loos & Co., Inc.

3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 603 galvanized -steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a Division of Cooper Industries.

2. Kinetics Noise Control, Inc.

3. Mason Industries, Inc.

4. TOLCO; a brand of NIBCO INC.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a Division of Cooper Industries.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.6 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for 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

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES .

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified.

B. Equipment and Hanger Restraints:

1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Engineer.
5. Test to 90 percent of rated proof load of device.

B. Seismic controls will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548.16

SECTION 260553- IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.

2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted or Write-on, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tapes not less than 3 mils thick by 1 to 2 inches wide.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.6 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black except where used for color-coding.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Control.

2. Power.

3. Communications.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors pull and junction boxes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

b. Colors for 208/120-V Power Circuits:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.

2) Phase B: Orange.

3) Phase C: Yellow.

d. Colors for 120 VAC Control Wire:

1) 120 VAC Control Power (Hot): Black

2) 120 VAC Control Power (Neutral): White

3) 120 VAC Control Circuit: Red

e. Colors for 24 VDC Control Circuits:

1) 24 VDC (+): Blue

2) 24 VDC (common): Blue with white stripe

f. Control wires energized by voltage source external to enclosure: Yellow

g. Colors for 4-20mA Signal Wire:

1) 4-20mA (+): Red

2) 4-20mA (-): Black

h. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes use, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.

F. Warning Labels for Indoor, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

   a. Controls with external control power connections.

G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

   b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

   c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.

   b. Enclosures and electrical cabinets.

   c. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

   d. Motor-control centers.

   e. Enclosed switches.

   f. Enclosed circuit breakers.

   g. Enclosed controllers.

   h. Push-button stations.

   i. Remote-controlled control devices.

   j. Monitoring and control equipment.

END OF SECTION 260553

SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 DIVISION 23 AND DIVISION 26 RESPONSIBILITIES

A. VFCs shall be furnished by Mechanical Division 23. Start-up, adjusting, demonstration, training and control wiring shall be by Mechanical Division 23

B. VFC installation, testing, power wiring and breaker setting shall be by Electrical Division 26.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. Section includes:
1. Separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
a. Integral input disconnecting means and OCPD

1.4 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.5 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Data: Certificates, for each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
b. Manufacturer's written instructions for setting field-adjustable overload relays.
c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:

1. ABB Low Voltage HVAC Drives.
2. Basis of Design: ABB Model ACH 580, Model PCR with input circuit breaker.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A or UL 508C.

B. Application: variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
7. Ambient Temperature Rating: Not less than 5 deg F (-15 deg C) and not exceeding 104 deg F (40 deg C).
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet (1000 m).
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.

11. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: NEMA Input Circuit Breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 125 percent of VFC input current rating.
2. Auxiliary Contacts: NO or NC, arranged to activate before breaker opens.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 CONTROLS AND INDICATION

A. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

B. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

C. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).
11. Status, warning, and alarm messages.

D. Control Signal Interfaces:

1. Electric Input Signal Interface:

a. A minimum of two programmable analog inputs: 0- to 10-V dc.
b. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:

a. 0- to 10-V dc.
b. 4- to 20-mA dc.
c. Potentiometer using up/down digital inputs.
d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of two programmable analog output signal(s) (0- to 10-V dc), which can be configured for any of the following:

a. Output frequency (Hz).
b. Output current (load).
c. DC-link voltage (V dc).
d. Motor torque (percent).
e. Motor speed (rpm).
f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

    a. Motor running.
    b. Set point speed reached.
    c. Fault and warning indication (overtemperature or overcurrent).
    d. PID high- or low-speed limits reached.

E. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: Two.

F. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.

1. Hardwired Points:

    a. Monitoring: On-off status.

    b. Monitoring: speed feedback
    c. Control: On-off operation.
    d. Control: speed command

2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC. Bacnet communications shall be included.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.6 OTHER FEATURES

A. Seismic Requirements: Fabricate and test VFCs according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.

2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. Damper control circuit with end-of-travel feedback capability.

C. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

D. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

E. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station or smoke-control fan controller, this password-protected input:

1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
2. Forces VFC to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
3. Causes display of override mode on the VFC display.
4. Reset VFC to normal operation on removal of override signal automatically.

F. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

G. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.7 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Indoors: NEMA Type 1.

2. Outdoors: NEMA Type 4.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.8 ACCESSORIES

A. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260548.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.

B. Spare control-wiring terminal blocks; unwired.

2.9 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to its specified motor.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in each fusible-switch VFC.

E. Install fuses in control circuits if not factory installed.

F. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.

4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager and Owner before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
    b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. VFCs will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 1.2 SUMMARY

A. Section includes lightning protection for structures.

1.3 SUBMITTALS

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

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

C. Provide a Compliance Review of the Specifications, Drawings and Addenda. The Compliance Review shall be a paragraph-by-paragraph review of the Specifications with the following information; “C”, “D” or “E” marked in the margin of the original Specifications and any subsequent Addenda.

1. “C”: Comply with no exceptions.
2. “D”: Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
3. “E”: Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.

D. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Bidder is in complete compliance with the plans and Specifications. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the Bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review. Bidders may submit the latest state-of-the-art components and their standard control components in lieu of the specified items. The Architect/Engineer must approve all deviations from the Specifications.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

C. Field quality-control reports.

D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.
2. Ground loop conductor.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL or LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

D. Coordinate down conductors with sleeves and penetrations provided in precast panels.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class I, copper unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. East Coast Lightning Equipment Inc.
b. ERICO International Corporation.
c. Harger.

d. Heary Bros. Lightning Protection Co. Inc.
e. Independent Protection Co.
f. Preferred Lightning Protection.
g. Robbins Lightning, Inc.
h. Thompson Lightning Protection, Inc.

2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
3. Air terminals shall be mounted a minimum of 36” (900mm) above the roof line on an air terminal mounting stand to minimize the risk to personnel walking on the roof during a snow event.

C. Main and Bonding Conductors: Copper.

D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

E. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors.

D. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components that are inaccessible. Provide listed connections for accessible connections.

E. Bond extremities of vertical metal bodies exceeding 10 feetin length to lightning protection components.

F. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of area or item indicated.

1. Bury ground ring not less than 24 inches from building foundation, structure or equipment.
2. Bond ground terminals to the ground loop.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Notify Engineer at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION 264113

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 LED luminaire requirements.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests[, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project, IES LM-79, and IES LM-80.
    a. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) 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. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
4. Structural members to which equipment and / or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Ceiling-mounted projectors.

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Product Test Reports: For each type of luminaire, for tests performed by a qualified testing agency.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

B. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).

1. Relative Humidity: Zero to 95 percent.

C. Altitude: Sea level to 1000 feet (300 m).

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. California Title 24 compliant.

2.3 LUMINAIRE ATTRIBUTES.

A. Refer to the lighting fixture schedule on drawings for a detailed description of each luminaire.

B. Lamp:
1. Dimmable (smooth and continuous) from 100 percent to 0 percent of maximum light output.
2. Internal driver.
3. User-Replaceable Lamps (where applicable):

a. Bulb shape complying with ANSI C78.79.
b. Lamp base complying with ANSI C81.61 or IEC 60061-1.

C. Housings:

1. Extruded-aluminum housing and heat sink.
2. Powder-coat painted finish.
3. Universal mounting bracket.
4. Integral junction box with conduit fittings.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers and Globes:
1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

F. With integral mounting provisions.

G. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp or wet locations as required per installation.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Owner, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Suspended Luminaires:

1. Ceiling Mount:

    a. Two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 10 feet (3 m) in length.

2. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

EXHIBIT “B”

DRAWINGS

PROJECT INTRODUCTION

The Project Consists Of The Following At The NJDWSC Wanaque South Pump Station Located At 310 Fairfield Road In Wayne, NJ:

- Replacement Of The Existing Hot Water Boiler And Three Pumps Located In The Mechanical Room. Two New Hot Water Boilers Along With Four Pumps Will Be Installed In Their Place. The Existing Heating Hot Water And Natural Gas Distribution Piping Will Remain And Be Reused And Modified As Required And Noted On Drawings.
- Replacement of The Two Existing Heating Only Rooftop Air Handlers Serving The Pump Room. Two New Air Handlers With Hot Water Coils And Local Thermostats Will Be Installed In Their Place.
- Replacement Of The Existing DX Cooling, Hot Water Heating Air Handler Located In The Mechanical Room. One New Air Handler With DX Cooling And Hot Water Heating And One New Exterior, Grade Mounted Condensing Unit Will Be Installed In Their Place.
- Replacement Of Nine Existing Hot Water Unit Heaters Located Throughout The Building.
- Replacement Of Ten Existing Roof Mounted Exhaust Fans
- Replacement Of Screen Room Lighting And Installation Of New Controls
- Relocation Of Existing Water Heater And Associated Piping

This Is A Single Prime Contract. The Awarded Contractor Will Be Responsible For Hiring The Services Of Licensed Subcontractors As Part Of The Project. This Shall Include All Necessary Labor And Materials For The Subcontractors Scope.

The Proposal Shall Include All Work Related To Modifications To The Existing Piping And Installation Of New Piping And Electrical Connections. All Questions And Clarifications Shall Be Submitted To The Owner And Addressed Before The Bids Are Finalized.

SCOPE OF WORK OVERVIEW

The Following Is A Brief Scope Of The Work For This Project (Not Intended To Be All Inclusive):

1. The Existing Cast Iron Sectional Boiler, Expansion Tanks, Pumps, Piping, Air Handlers, Ductwork, And Accessories Will Be Removed As Noted And Disposed Of By The Contractor.
2. Contractor Shall Be Responsible For Application Of All Local Building Department Permits, Registration Of Boiler With Appropriate State Agency, And Any Required Testing. Owner Will Obtain DCA Plan Approval And Contractor To Obtain Construction Permits. All Permit Applications To Be Reviewed By Owner Before Submittal To DCA.
3. Boilers And All Supplemental Equipment Shall Be Started Up By Approved Vendor Personnel And Commissioned To Confirm Proper Performance And Operating Conditions.
4. All Coloring And Labeling Of New Piping Shall Match Existing.
5. Perform Boil-Out And Cleaning Procedures According To Manufacturer's Written Instructions. Boiler Shall Be Washed And Flushed Until Water Leaving Boiler Is Clear. Contractor Shall Dispose Of All Water And Chemicals Used During Flushing In An Approved Manner. No Chemicals Shall Be Dumped Into Floor Drains.
6. Existing Floor Drains Shall Be Scoped Out And Cleaned After Construction Is Complete.
7. Floors To Be Finished Where Pads Are Demolished.
8. Existing Chimney / Flue Shall Be Removed And Replaced With New Category IV Breeching For Condensing Boiler Application. Existing Roof Penetration Shall Be Resealed To Accommodate New Breeching.
9. All Valves Shall Have A Position Indicator.
10. Replace Screen Room Lighting. New Motorized Lowering System Shall Be Provided To Facilitate Maintenance.
11. No Hazardous Materials Were Identified In The Project Areas By The Owner And Abatement Is Not Included In This Scope.
12. All Construction Phasing Shall Be Coordinated With The Owner Prior To The Start Of The Project.
13. Contractor Shall Drain, Clean, Passivate, And Refill All Domestic And Heating Water Piping.
14. Provide Air Vents At All High Points And Valved Drains In All Low Points Of Hydronic Systems.
15. Refer To Technical Specification Section 230130.51 For Details On Optional Duct Cleaning. See Note 3 On M101 For Additional Information.

SPECIAL EMPHASIS, CONCERNS, & LIMITATIONS

Communication

1. The Engineer And Owner Shall Be Notified Immediately Upon Discovery Of A Problem Or Conflict. Contractor Shall Promptly Identify One Or More Proposed Solutions But Shall Not Proceed Until So Authorized.
2. All Required Shutdowns Must Be Coordinated With The Owner And Limited To A Minimum In Order For The Owner To Maintain Their Services Throughout The Day.

Construction

1. Submittals (Shop Drawings) Shall Be Provided For Each Piece Of Purchased Equipment. Ensure Thoroughness And Accuracy Of The Submittals. The Contractor Shall Provide A Stamp On The Shop Drawings Stating That They Conform To The Specifications.
2. Long Lead Items Must Be Ordered Promptly To Ensure Timely Deliveries.
3. All Work Must Follow The Proposed Layout Shown In The Construction Drawings. Change Orders Will Not Be Authorized So All Estimates Must Be Very Specific.
4. All Work Shall Be Performed During Normal Hours Unless Other Arrangements Are Made And Authorized.

APPLICABLE CODES AND REFERENCES

General

Entire Installation Shall Comply With All Local And State Codes And Other Authorities Having Jurisdiction.

Applicable Codes And References (State Of New Jersey)

1. Building Code: International Building Code (IBC) - 2021 Edition
2. Plumbing Code: National Standard Plumbing Code (NSPC) - 2021 Edition
3. Mechanical Code: International Mechanical Code (IMC) - 2021 Edition
4. Electrical Code: National Electrical Code (NEC) - 2020 Edition
5. Energy Code: ASHRAE 90.1 - 2019
6. Fire / Life Safety Code: New Jersey Uniform Construction Code (UCC)
7. Fire Protection: NFPA Sections 13 & 14 - Latest Adopted Version, NFPA 25, And NFPA 72
8. Fuel Gas Code: International Fuel Gas Code (IFGC) - 2021 Edition
9. ASHRAE Handbooks

Acronym Key

ASHRAE: American Society Of Heating, Refrigerating And Air Conditioning Engineers

IESNA: Illuminating Engineering Society Of North America

NFPA: National Fire Protection Association

SMACNA: Sheet Metal & Air Conditioning Contractors' National Association

SEISMIC DESIGN CRITERIA

Seismic Data

Mapped Spectral Acceleration - Short Periods (SMS):	0.411g
Mapped Spectral Acceleration - 1 Second Period (SM1):	0.170g
Soil Site Classification:	D
Seismic Occupancy Category:	IV
Seismic Design Category:	C

Seismic Requirements

1. This Building Is Classified As Seismic Design Category C Per IBC 2021. Mechanical And Electrical Components And Systems In Buildings That Are Assigned To Seismic Design Category C In Seismic Occupancy Catagory IV Structures Are Not Exempt From Seismic Requirements Per ASCE-7 13.1.4.
2. Provide Seismic Bracing Of Mechanical And Electrical Components And Systems.

DOCUMENT ORGANIZATION

Drawing Organization

The Primary Organization And Order Of The Project Drawing Set Is Determined By The Trade. The Preface Letter(s) Of The Drawing Name Indicates The Trade.
1. General Sheets (G Series)
2. Mechanical (M Series)
3. Electrical (E Series)

Drawing Sequence

1. Within Each Trade, Drawings Start With Overview "Big Picture" Information, Then Plan Views, Followed By All Other Pertinent Information. Where Effective, Supplemental Information Is Included Directly On The Plan View Drawings To Improve The Reader's Understanding.

Miscellaneous

1. The Terms 'Sheet', 'Plan', And 'Drawing' Are Used Interchangeably.
2. For Items That Are Plans, Details, And Other Graphic Items, Titles Are At The Bottom Of The Item Described. For Items That Are Predominately Text Such As Schedules, Titles Are At The Top Of The Item Described.
3. Shading Of An Area Often Is Used To Emphasize An Area To The Reader. Some Of The Possible Purposes Of This Emphasis Can Be:
   A. Identify Major Pieces Of Equipment
   B. Defining A Topics Boundary Without Conflicting With Other Linework
   C. Help To Emphasize The Existence Of A Part Plan Of The Area
   D. Differentiate Line Work In Congested Areas

How Notes Are Used

1. General Notes Are One Or More Notes In List Form Which Are Not Indicated Specifically On A Plan, Section, Elevation, Or Detail.
2. Key Notes Are Used In Lieu Of Standard Notes Where They Improve Readability, Key Notes Are Gathered Together And Listed Collectively On The Drawings On Which They Are Located.

Addenda & Revisions

Some Addenda And Revisions Are Identified On The Drawings Using A (1). The Number In The Triangle Links To The Revision Block In The Title Block Section.

Sometimes The Most Recent Change Is Clouded To Provide Increased Clarity.

PROJECT GENERAL NOTES

General

1. All General Notes Are To Be Read And Adhered To By Each Contractor. The Notes Are Loosely Categorized By Trade, But This Does Not Limit The Resposibility Of The Contractor To Any Single Category.
2. Entire Installation Shall Comply With All Local And State Codes And Other Authorities Having Jurisdiction.
3. Proper Fire Protection Measures, Satisfactory To The Local Fire Department, Shall Be Taken When Welding Or Cutting With Torches Or Electric Arc. Contractor To Provide Open Flame Permit If Required. A Hot Permit Must Be Obtained From The Owner.
4. All Drawings Are Conceptual And Contractor Shall Provide Construction Drawings For Approval By Owner Prior To Installation.

Coordination

1. Contractor To Visit Job Site And Verify Existing Field Conditions Prior To Submission Of Bid.
2. Contractor Shall Secure And Pay For All Required Permits And Shall Arrange All Required Inspections. This Includes But Is Not Limited To Stack Permits And Low NOx Testing.
3. Contractor Shall Coordinate His Work With The Existing Field Conditions.

Installation

1. Contractor Shall Be Responsible For All Cutting And Patching Of Walls, Ceilings, Roofs And Floors Required As A Result Of His Work.
2. Piping And Duct Layouts Are Schematic Diagrams And Are Intended To Show General Arrangement, Size And Capacity And Do Not Indicate Which Pipe Or Duct Is Above Or Below The Other. All Offsets Are Not Necessarily Shown. Contractor Shall Arrange And Coordinate The Work, Furnish Necessary Offsets, Valves, Vents And Fittings To Avoid Conflict With Other Mechanical And Electrical Services And Structural And Architectural Elements Without Additional Cost To The Owner. If Areas Of Conflict Are Encountered, The Construction Manager Shall Be Notified And Contractors Shall Submit Recommendations For Approval Before Work Has Begun.
3. All Support Systems (Supports, Hangers, Anchors, Guides, Bracing, Fasteners, Welds, Etc.) For Equipment And Systems Installed Or Revised As Part Of This Contract Shall Be Designed, Selected And Installed By The Contractor To Resist All Seismic, Wind And Gravity Loads. The Codes Listed Under The "Design Criteria" Section Of These Documents Have Specific Requirements Concerning The Application Of These Loads As Well As Other Design Requirements. Under Certain Conditions, The Applicable Codes Require These Loads, Or A Combination Of These Loads, Be Considered As "Coincidental". The Contractor Shall Also Be Responsible For Confirming That The Component Of The Building Structure Where These Support Systems Are Attached Is Able To Resist The Design Loads Transferred To This Building Component. The Contractor Is To Provide Seismic Design Drawings And Details From A Seismic Engineer. The Drawings Are To Be Signed And Sealed Per Specifications.
4. All Penetrations Of Floors (Whether Or Not Fire Resistance Rated) And All Penetrations Of Fire Rated Walls And Floors Shall Be Provided With A Through-Penetration Protection System (Firestopping). Each Through-Penetration Protection System Shall Be Tested In Accordance With ASTM E814 And Be Listed For The Type Of Floor Or Wall Assembly Penetrated And The Type Of Installation. Installers Must Be Trained And Certified.
5. Contractor Shall Provide All Necessary Miscellaneous Steel For The Support Of All Equipment, Piping, And Conduit Suspended From Slab, Steel, Wall, Trusswork, And Roof Openings.
6. "Furnish And Install" Or "Provide" Means To Supply, Erect, Install And Connect Up To Complete For Readiness For Regular Operation, The Particular Work Referred To.
7. No Imposed Loads Shall Be Placed On Any New Or Existing Equipment.

MECHANICAL / ELECTRICAL COORDINATION

1. Power Wiring To Mechanical Equipment, Motor Controllers And Control Panels Shall Be Provided By The Electrical Contractor Who Will Be Hired And Work As A Subcontractor To The Mechanical Contractor.
2. Control Wiring Shall Be Provided By The Contractor As Part Of This Project.
3. Motor Controllers, Motor Starters And Disconnects Shall Be Furnished And Installed As Part Of This Project.
4. Disconnect Switches Shall Be Heavy Duty Type With Lockable Handle. Disconnects For All Electrically Driven HVAC Equipment Shall Be Furnished And Installed By The Contractor. One Manufacturer Shall Be Used Throughout The Project. Acceptable Manufacturers Are: Square D, General Electric, Siemens And Westinghouse.
5. Starters Shall Be NEMA Combination Magnetic Motor Starters Sized Per Motor HP, With Integral Red Run Pilot Light And H-O-A Switch. Coordinate Motor Starter Type And Features With The Requirements Of The Mechanical Equipment And The Control System. Provide Overload, Under Voltage And Phase Loss Protection In All Starters. Starters For Motors 50 HP And Larger Shall Be Reduced Voltage Autotransformer Type. One Manufacturer Shall Be Used Throughout The Project. Acceptable Manufacturers Are: Toshiba Or Approved Equal.

General

1. Contractor Shall Ensure That All Mechanical Devices Will Be Installed In A Location Which Affords Accessibility For Maintenance And Repair And Shall Be Approved By Owner Prior To Installation. Coordinate Installation Among All Trades To Avoid Interferences, And Locate Equipment To Provide Clearances Which Exceed Those Recommended By The Equipment Manufacturer. Prior To Project Completion, Representatives Of DLB Associates Will Review Each Installation And Will Direct Changes Whenever Access Or Serviceability Is, In Their Opinion, Unacceptable.

KEY PARTICIPANTS & THEIR ROLES

Owner

North Jersey District Water Supply Commission
One F.A. Orechio Drive
Wanaque, NJ 07465

Contact: Chris Clamser
Email: cclamser@njdwsc.com
Tel: (973) 390-3032

Mechanical / Electrical / Plumbing

DLB Associates
3600 Route 66, Suite 150 - #5981
Neptune, NJ 07753

Contact: Dan Rehberg - Project Manager
Email: drehberg@dlbassociates.com
Tel: (732) 318-0314

DCA REVIEW

No.	Drawing Title	Issues
		Issued for Bid and DCA Review 06/23/23
GENERAL INFORMATION FOR ALL TRADES		
G101	General Information Sheet - 1	A
G102	General Information Sheet - 2	A
G103	Photo Overview	A
STRUCTURAL		
S-001	General Structural And Construction Notes	A
S-101	Partial Existing Slab On Grade Plan And New Exterior Platform Framing Plan	A
S-102	Partial Existing Roof Framing Plan	A
PLUMBING		
P101	Boiler Room Demolition Plan	A
P102	Boiler Room New Work Plan	A
MECHANICAL		
M101	Building Overview Demolition Plan	A
M102	Building Overview New Work Plan	A
M103	Roof New Work Plan	A
M104	Boiler Room Demolition Plan	A
M105	Boiler Room New Work Plan	A
M201	Details - 1	A
M202	Details - 2	A
M203	Schedules	A
M500	Controls Details - 1	A
M501	Controls Details - 2	A
ELECTRICAL		
E101	Demolition Plan	A
E102	New Work Plan	A
E103	Electrical Notes And Lighting Schedule	A
E104	Panel Schedules - 1	A
E105	Panel Schedules - 2	A

REV.	DATE	ISSUE DESCRIPTION	ITEM	DATE	ISSUE DESCRIPTION
A	6/23/23	ISSUE FOR BID AND DCA REVIEW			

dlbassociates consulting engineers
3600 Route 66, Suite 150 - #5981
Neptune NJ 07753
Questions For DLB Call: Dan Rehberg
DLB Project ID: 12636 Phone: 732-318-0314

project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
GENERAL INFORMATION SHEET - 1

scale	drawn by	checked by	date	filename
AS SHOWN	CAD	DR	06/09/2023	12636G101

dwg. no.
G101

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24x36

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GENERAL STRUCTURAL AND CONSTRUCTION NOTES

DCA REVIEW

1.0 GENERAL

1. All work shall conform to the "2021 International Building Code" and to all other applicable Federal, State, and Local regulations.
2. In case of conflict between the General Notes, Specifications, and details, the most rigid requirements shall govern.
3. Work not indicated on a part of the drawings but reasonably implied to be similar to that shown at corresponding places shall be repeated.
4. Job site safety and construction procedures are the sole responsibility of the Contractor.
5. The Contractor shall provide for dewatering as required during excavation and construction.
6. All costs of investigation and/or redesign due to Contractor improper installation of structural elements or other items not in conformance with the Contract Documents shall be at the Contractor's expense.
7. The structural drawings shall be used in conjunction with the specifications, and mechanical drawings. If there is a discrepancy between drawings, it is the Contractor's responsibility to notify the Engineer prior to performing the work.
8. If the existing field conditions do not permit the installation of the work in accordance with the details shown, the Contractor shall notify the Engineer immediately and provide a sketch of the condition with his proposed modification of the details given on the Contract Documents. Do not commence work until condition is resolved and modification is approved by the Engineer.
9. Shop drawings for all structural materials to be submitted to Engineer for review prior to the start of fabrication or commencement of work. Review period shall be a minimum of two (2) weeks.
10. Reproduction of any portion of the Structural Contract Drawings for resubmittal as shop drawings is prohibited. Shop drawings produced in such a manner will be rejected and returned.
11. Shop drawings submitted for structural review shall consist of two (2) sets of prints and one (1) set of reproducibles. Only one (1) marked up set of reproducible with the Structural Engineer's comments will be returned to the Contractor.
12. Shop drawings shall bear the Contractor's stamp of approval which shall constitute certification that the Contractor has verified all construction criteria, materials, and similar data and has checked each drawing for completeness, coordination, and compliance with the Contract Documents.
13. The shop drawings shall include dimensioned grating edges.
14. The drawings have been produced entirely on MPP Engineers Cadd System. Any other lettering, lines or symbols, other than professional stamps and signatures, have been made without the authorization of MPP Engineers are invalid.
15. The structural drawings shall govern the work for all structural features, unless noted otherwise.
16. All materials shall be stored to protect them from exposure to the elements.

2.0 FOUNDATIONS

1. Foundations have been designed for an allowable bearing capacity and footing elevations established based upon adjacent building information, known information from adjacent sites, and similar soil conditions in the project vicinity. A new Subsurface Investigation Report, with foundation recommendations, has not been provided by the Owner for this project at this time. The soil information and bearing capacity shall be verified by a qualified Geotechnical Engineer during construction.
2. Footings shall bear on undisturbed stratum or engineered fill with a minimum bearing capacity of 1,000 psf.
3. Prior to footing concrete placement, the footing subgrade shall be approved by the inspecting Geotechnical Engineer. If conditions prove to be unacceptable at elevations shown, footing bottoms shall be lowered to acceptable subgrade material. Fill over-excavation with lean concrete (2,500 psi).
4. The bottom of exterior footings shall be a minimum of 4'-6" below finished grade, or as required by Local building codes.
5. Concrete for foundations shall be poured on the same day the subgrade is approved by the Geotechnical Engineer.
6. The Contractor shall observe water conditions at the site and take the necessary precautions to ensure that the foundation excavations remain dry during construction. Any sheeting or shoring required for dewatering shall be the responsibility of the Contractor.
7. The Contractor shall be responsible for coordinating the need to use foundation rebar as a grounding electrode system and shall be responsible for installing the bonding clamp prior to placement of the concrete as per NJUCC Bulletin No. 02-2.

3.0 CAST-IN-PLACE CONCRETE

1. Concrete shall be designed and detailed in accordance with the Building Code Requirements for Structural Concrete (ACI-318-08), and constructed in accordance with the CRSI Manual of Standard Practice.
2. Concrete shall have a minimum compressive 28-day strength of 5,000 psi. Air Entrainment 5.5% to 8% in all exposed concrete work.
3. Maximum water/cement ratios:
   A. Foundations 0.44
4. All concrete shall be normal weight concrete (144 pcf +) with all cement conforming to ASTM C150, Type I. Maximum aggregate size shall be 1½" for footings and ¾" for walls and slabs, conforming to ASTM C33.
5. Reinforcing steel: ASTM A615 Grade 60.
6. Submit to Engineer reinforcing steel shop drawings for approval and mix designs for review prior to placing any concrete.
7. All reinforcement shall be securely held in place while placing concrete. If required, additional bars, stirrups or chairs shall be provided by the Contractor to furnish support for all bars.
8. Placing of concrete shall not start until the placement of reinforcing has been approved by the Inspection Agency.
9. Concrete shall not be pumped through aluminum pipes and shall not be placed in contact with aluminum forms, mixing drums, buggies, chutes, conveyors or other equipment made of aluminum.
10. All inserts and sleeves shall be cast-in-place.
11. Chamfer all exposed concrete corners unless noted otherwise.
12. Early drying out of concrete, especially during the first 24 hours, shall be carefully guarded against. All surfaces shall be moist cured or protected using a membrane curing agent applied as soon as forms are removed. If membrane curing agent is used, exercise care not to damage coating.
13. Cold weather concreting shall be in accordance with ACI-306. Hot weather concreting shall be in accordance with ACI-305R.
14. Throughout construction, the concrete work shall be adequately protected against damage due to excessive loading, construction equipment, materials or methods, ice, rain, snow, excessive heat, and freezing temperatures.

4.0 STRUCTURAL STEEL

1. Fabrication and erection of structural steel shall conform to the "Steel Construction Manual", Thirteenth Edition, 2005, American Institute of Steel Construction including Specifications for Structural Steel Buildings, Specification for Structural Joints Using ASTM A325 or A490 Bolts, and AISC Code of Standard Practice except Sections 4.2 and 7.9 which shall not be applicable to this project.
2. All welding shall be performed by certified welders and shall conform to "Structural Welding Code ANSI/AWS D1.1-92", American Welding Society.
3. Wide flange shapes: ASTM A992 or A572, Grade 50.
4. Structural shapes & plates: ASTM A36, A572 or A992.
5. Galvanized structural steel:
   A. Structural shapes and rods ASTM A123.
   B. Bolts, fasteners and hardware ASTM A153.
6. All bolted connections shall be with ASTM A325 high strength bolts ¾" minimum diameter, unless noted otherwise.
7. Welding electrodes shall be E70XX for manual arc welding and F7X-EXXX for submerged arc welding. All welders shall be certified by the AWS. Minimum weld size shall be 3/16" unless noted otherwise.
8. Submit shop drawings for fabrication and erection of structural steel. Clearly indicate coordinated dimensions of mechanical unit and roof penetration sizes. Shop and Erection drawings must show all shop/floor and field welds. Initial shop drawing submittal shall include proposed connection details and job standards. Provide signed and sealed calculations for all non-standard connection details showing design capacities.
9. Alternate connection details may be used if such details are submitted to the engineer for review and approval. However, the engineer shall be the sole judge of acceptance and the Contractor's bid shall anticipate the use of those details shown on the drawings. The Contractor is responsible for the design of such alternate details which he proposes.
10. All exterior exposed structural steel shall be hot-dipped galvanized per ASTM A123.
11. Field welded surfaces within four (4) inches of weld shall be cleaned and ground smooth. After welding coat the exposed area with galvanizing repair paint. Galvanizing repair paint shall be a high zinc dust content paint complying with Federal Specifications DOD-P-21035A or SSPC-Paint-20, Cold Galvanizing Compound by ZRC Products Co. or equal.
12. Steel grating shall be manufactured in accordance with the Metal Bar Grating Manual by the National Association of Architectural Metal Manufacturers and shall conform to Federal Specification RR-G-661E, Type I, Class I. Steel for grating shall be ASTM A569. All grating shall be galvanized and attached with removable type fasteners.
13. Visually inspect all fillet welds.

5.0 DESIGN DATA

1. Governing Code: International Building Code 2021
2. Platforms Live Load:
   Catwalks Uniform.....60 PSF
3. Snow Load
   Pg (Ground Snow Load).....30 PSF
4. Wind Load:
   A. Basic Wind Speed.....128 MPH
   B. I (Wind Importance Factor).....1.0
   C. Wind Exposure.....C
   D. Wind Direction.....As per the Code
5. Special Loads:
   A. Dead Loads:
      1. Materials Of Construction
         i. Framing.....2 PSF
         ii. Grating.....10 PSF
      2. Fixed Service Equipment
         i. Mechanical Equipment –.....SEE PLAN

REV.	DATE	ISSUE DESCRIPTION	ITEM	DATE	ISSUE DESCRIPTION
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PROJECT
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

TITLE
GENERAL NOTES

SCALE	DRAWN BY	CHECKED BY	DATE	FILENAME
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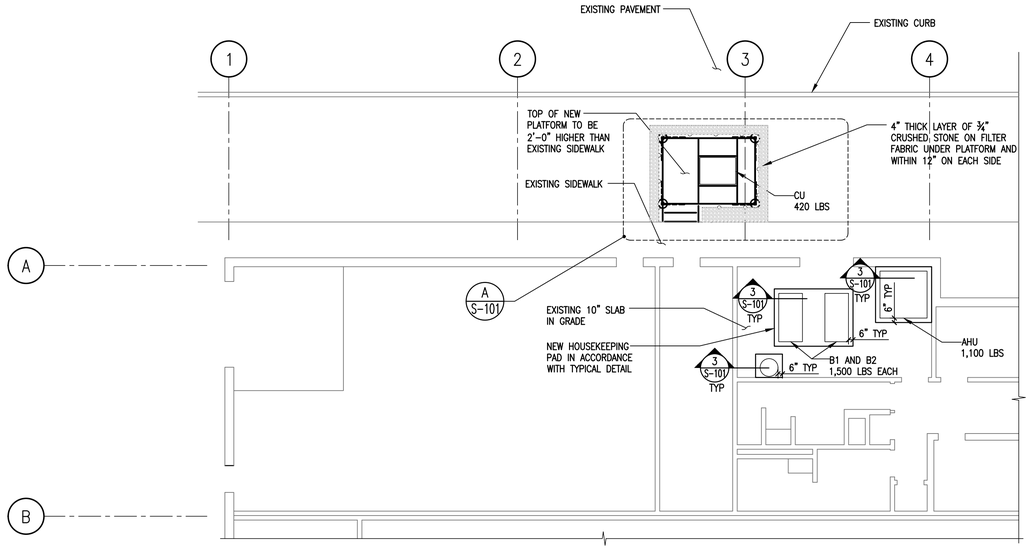
DWG. NO.
S-001

24x36

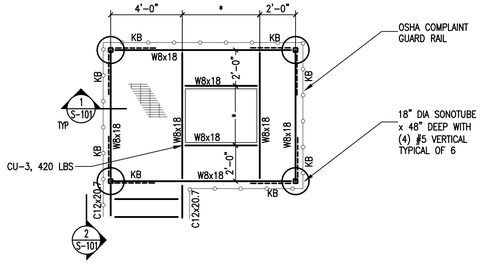


PARTIAL EXISTING SLAB ON GRADE PLAN AND NEW EXTERIOR PLATFORM FRAMING PLAN

SCALE: 1/8" = 1'-0" (DO NOT SCALE PLAN)

NOTES:

1. THE GC SHALL FIELD VERIFY LOCATIONS OF ALL EXISTING UTILITIES PRIOR TO EXCAVATION. HAND EXCAVATE WITHIN 2' OF ANY EXISTING UTILITY LINES.

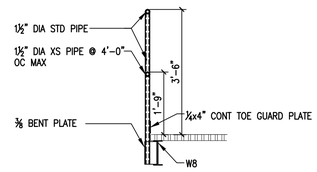


PLATFORM FRAMING PLAN

A S-101 SCALE: 1/4" = 1'-0" (DO NOT SCALE PLAN)

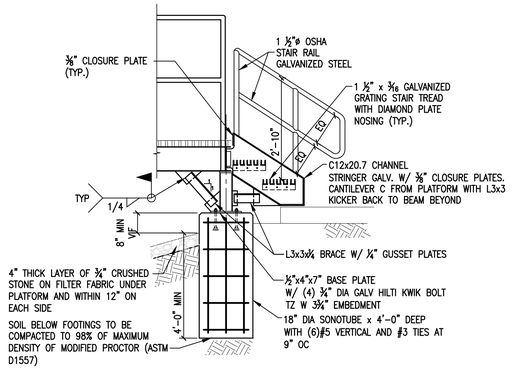
NOTES:

1. ALL PLATFORM STEEL SHALL BE HOT DIPPED GALVANIZED.
2. G — DENOTES SPAN OF 1"x 3/16" GALVANIZED STEEL BAR GRATING. TACK WELD GRATING TO SUPPORTS.
3. KB – DENOTES L3x3x¼ KNEE BRACE
4. THE GC SHALL OBTAIN MANUFACTURER'S DRAWINGS FOR EQUIPMENT SHOWN AND VERIFY ALL DIMENSIONS ASSOCIATED WITH SUPPORT OF EQUIPMENT SHOWN THUS (*) ON PLAN WITH ACTUAL SIZE OF PURCHASED EQUIPMENT PRIOR TO FABRICATING STEEL.
5. THE GC SHALL FIELD VERIFY LOCATIONS OF ALL EXISTING UTILITIES PRIOR TO EXCAVATION. HAND EXCAVATE WITHIN 2' OF ANY EXISTING UTILITY LINES.



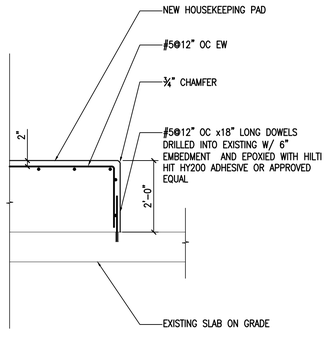
1 S-101 SECTION

SCALE: 1/2" = 1'-0"



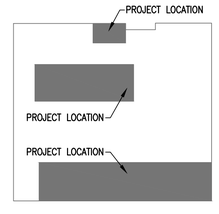
2 S-101 SECTION

SCALE: 1/2" = 1'-0"

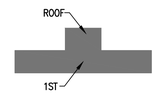


3 S101 SECTION

SCALE: 1/2" = 1'-0"



KEY PLAN



VERTICAL PLAN

DCA REVIEW

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PROJECT
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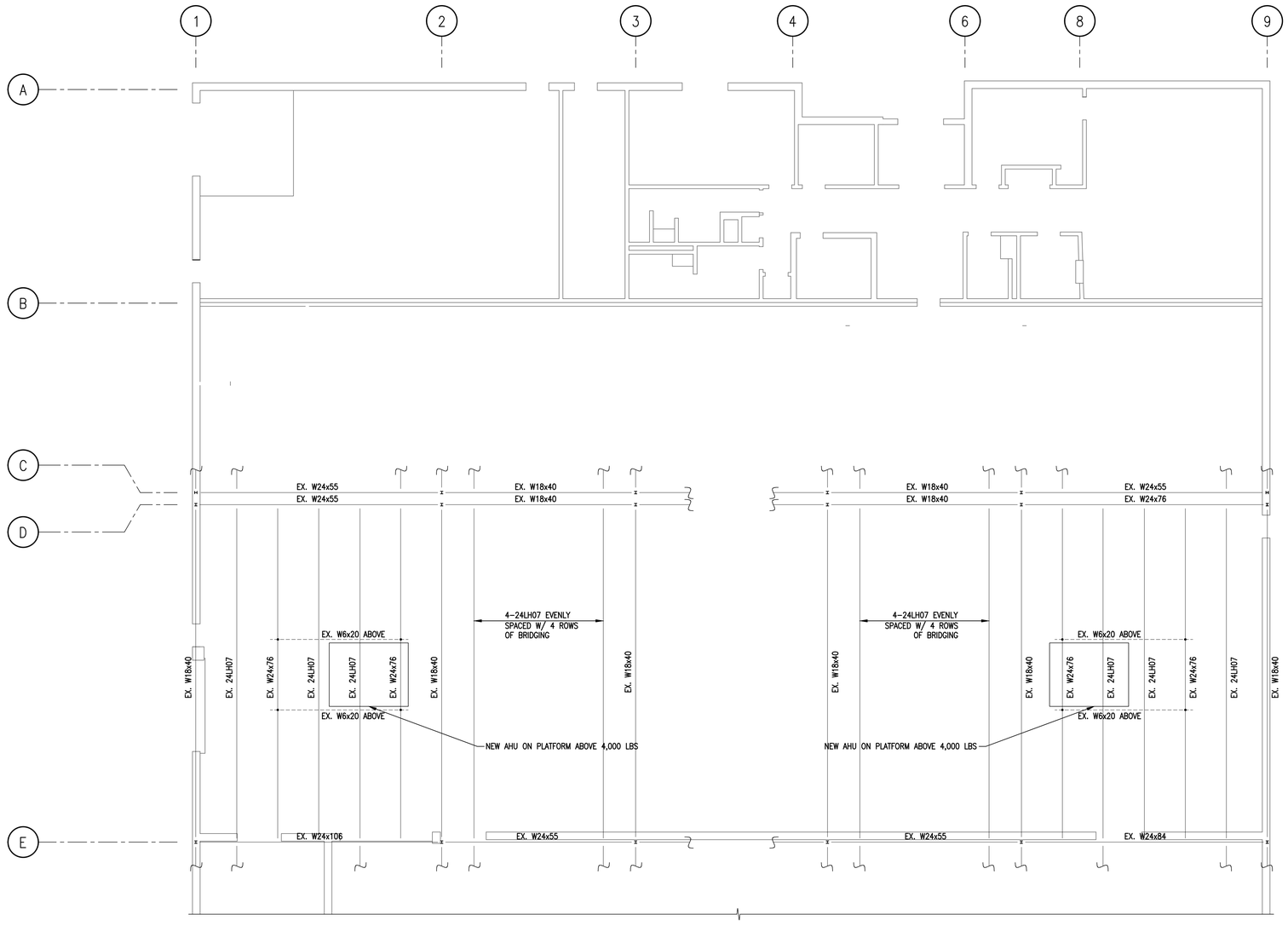
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

TITLE
PARTIAL EXISTING SLAB ON GRADE PLAN AND NEW EXTERIOR PLATFORM FRAMING PLAN AND SECTIONS

SCALE	DRAWN BY	CHECKED BY	DATE	FILENAME
AS SHOWN	MPP	DGP	04/06/2023	22-0272 WSPS

DWG. NO.
S-101

24x36



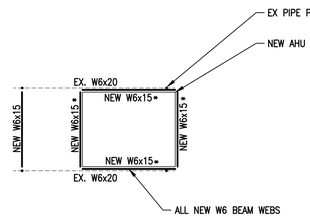
PARTIAL EXISTING ROOF FRAMING PLAN

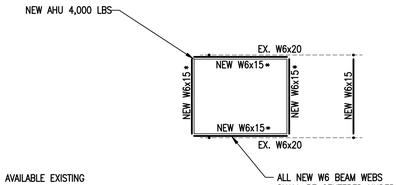
SCALE: 1/8" = 1'-0" (DO NOT SCALE PLAN)

NOTES:

1. EXISTING FRAMING & SIZES SHOWN FOR REFERENCE ONLY AND ARE BASED ON AVAILABLE EXISTING DRAWINGS. CC SHALL VERIFY ALL EXISTING, SIZES, CONDITIONS AND DIMENSIONS SHOWN PRIOR TO FABRICATION AND INSTALLATION OF STEEL AND BRING ANY CONFLICTS OR DISCREPANCIES TO THE IMMEDIATE ATTENTION OF THE ENGINEER.

DCA REVIEW





AHU ROOF TOP SUPPORT FRAMING PLAN

SCALE: 1/8" = 1'-0" (DO NOT SCALE PLAN)

NOTES:

1. EXISTING FRAMING & SIZES SHOWN FOR REFERENCE ONLY AND ARE BASED ON AVAILABLE EXISTING DRAWINGS. GC SHALL VERIFY ALL EXISTING, SIZES, CONDITIONS AND DIMENSIONS SHOWN PRIOR TO FABRICATION AND INSTALLATION OF STEEL AND BRING ANY CONFLICTS OR DISCREPANCIES TO THE IMMEDIATE ATTENTION OF THE ENGINEER.
2. ALL NEW STEEL SHALL BE PAINTED WITH TWO COATS OF CARBOGUARD 890 BY CARBOLINE OR APPROVED EQUAL. CLEAN AND PAINT EXISTING W6 BEAMS AND PIPE POSTS WITH ONE COAT OF CARBOGUARD 890 BY CARBOLINE OR APPROVED EQUAL.
3. THE GC SHALL OBTAIN MANUFACTURER'S DRAWINGS FOR EQUIPMENT SHOWN AND VERIFY ALL DIMENSIONS ASSOCIATED WITH SUPPORT OF EQUIPMENT SHOWN THUS (*) ON PLAN WITH ACTUAL SIZE OF PURCHASED EQUIPMENT PRIOR TO FABRICATING STEEL.

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1	4/14/23	ISSUED FOR REVIEW			

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310 FAIRFIELD ROAD
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TITLE
PARTIAL EXISTING ROOF FRAMING PLAN

SCALE	DRAWN BY	CHECKED BY	DATE	FILENAME
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DWG. NO.
S-102

GENERAL SYMBOL LIST

Identifier	Description
1	Keynote Symbol
2	Keynote With Leader
3 4	Multiple Keynotes Applying To The Same Item
	Connect To Existing
	Disconnect From Existing
	Existing Equipment
	Demo Equipment
	New Equipment
	Detail Identifier
E4 / 01	Drawing # (Detail Location) Detail #
	Section Identifier
E4 / 02	Drawing # (Detail Location) Detail #
	Elevation Identifier
M2 / 02	Drawing # (Detail Location) Detail #
XXXX / XX	Equipment Type Equipment Number

GENERAL NOTE:
1. Symbols And Abbreviations Lists Are Shown For General Reference Only. The Presence Of A Symbol Or Abbreviation Does Not Imply Its Use On This Project. Refer To Drawings For Specific Symbols Used.

GENERAL ABBREVIATIONS

Identifier	Description
A	Amps
AFF	Above Finished Floor
AFG	Above Finished Grade
BFG	Below Finished Grade
BLDG	Building
BOB	Bottom Of Beam
CL	Center Line
CLG	Ceiling
CO	Company
CONTR	Contractor
DIA, Ø	Diameter
DEG, °	Degrees
DN	Down
DWG(S)	Drawing(s)
EC	Electrical Contractor
EM	Emergency
EQUIP	Equipment
ETR	Existing To Remain
EX	Existing
FLA	Full Load Amps
FS	Flow Switch
FT	Feet
GC	General Contractor
HP	Horsepower
IN	Inches
K	Thousand
LRA	Locked Rotor Amps
MAX	Maximum
MC	Mechanical Contractor
MCA	Minimum Circuit Amps
MFR	Manufacturer
MH	Mounting Height
MIN	Minimum
MTD	Mounted
NIC	Not In Contract
NTS	Not To Scale
OC	On Center
PC	Plumbing Contractor
PSI	Pounds Per Square Inch
PVC	Polyvinyl Chloride
R	Existing Equipment To Be Removed
RL	Existing Equipment To Be Relocated
RLA	Running Load Amps
RPM	Revolutions Per Minute
SDD	Smoke Duct Detector
SQ. FT., SF	Square Feet
T	Thermostat
TRF	Transfer Fan
TS	Tamper Switch
TYP	Typical
UNO	Unless Noted Otherwise
VAV	Variable Air Volume
VFD	Variable Frequency Drive

MECHANICAL SYMBOL LIST

Identifier	Description
CD	Air Conditioning Condensate Drain
HWS	Heating Water Supply
HWR	Heating Water Return
	New Piping
	Existing Piping To Remain
	Existing Piping To Be Removed
	Pipe Riser
	Pipe Drop On Direction Of Flow
	Capped Pipe
	Direction Of Flow
P	Pitch Of Pipe (Down)
	Reducer / Increaser
	Pipe Vibration Isolator
	Pipe Anchor
	Pipe Guide
	Union Or Flanged Connection, As Required
	Gate Valve
	Butterfly Valve
	Check Valve
	Ball Valve
	Lubricated Plug Cock / Gas Cock
	Adjustable Pressure Relief Valve
	Calibrated Orifice Balancing Valve
	Balancing Valve
	Control Valve
	Automatic Air Vent With Ball Valve
	Manual Drain (Ball Valve With Hose Connection And Cap)

Identifier	Description
	Manual Air Vent (Ball Valve W/ U-Bend, Hose Connection And Cap)
	Pressure Gauge With Ball Valve
	Thermometer And Well
	Strainer With Full Size Blow Down Ball Valve, Hose Connection & Cap
	New Ductwork
	Existing Ductwork To Remain
	Existing Ductwork To Be Removed
	Insulated Flexible Duct
	Volume Damper
M	Motorized Damper
X XXX	Diffuser / Register / Grille Number, CFM
CFM, ∫	Cubic Feet Per Minute
	Supply Air Flow
	Exhaust Air Flow
	4 Way Ceiling Diffuser
	3 Way Ceiling Diffuser
	2 Way Ceiling Diffuser
	1 Way Ceiling Diffuser
	Floor Diffuser (With Damper)
	Exhaust Grille / Return Register
	Supply Duct Up
	Return / Exhaust Duct Up
	Supply Duct Down
	Return / Exhaust Duct Down
T	Thermostat

MECHANICAL ABBREVIATIONS

Identifier	Description
AD	Access Door
BTU	British Thermal Units
CD	Ceiling Diffuser
CFM	Cubic Feet Per Minute
COND	Air Conditioning Condensate
CR	Ceiling Register
CU	Condensing Unit
DB	Dry Bulb
EAT	Entering Air Temperature
EF	Exhaust Fan
EG	Exhaust Grille
ESP	External Static Pressure
EWB	Entering Wet Bulb
FDAD	Fire Damper And Access Door
FD	Fire Damper
FSD	Fire Smoke Damper
FPM	Feet Per Minute
G	Gas
GPM	Gallons Per Minute
HVAC	Heating, Ventilation, And Air Conditioning
LAT	Leaving Air Temperature
MAU	Make Up Air Unit
MBH	Thousand BTU Per Hour
MOD	Motor Operated Damper
OA	Outside Air
OAI	Outside Air Intake
OPNG	Opening
OPWT	Operating Weight
PSI	Pounds Per Square Inch
RA	Return Air
RG	Return Grille
RTU	Rooftop Unit
SC	Self Contained Control Valve
SD	Smoke Damper
SDD	Smoke Duct Detector
SR	Supply Register
TA	Transfer Assembly
TO	Transfer Opening
TT	Thermostatic Trap
UV	Unit Ventilator
VIC	Vibration Isolation Connection
WC	Water Column
WG	Water Gauge

ELECTRICAL SYMBOL LIST

Identifier	Description
	Electrical Conduit
	Electrical Conduit Run Concealed Via Floors, Walls, Underground
	Conduit Homerun
	Conduit Turned Up
	Conduit Turned Down
	Conduit End (Capped)
	Duplex Receptacle, 20A, 120V
GFI	Ground Fault Interrupting Receptacle, 20A, 120V
GFI	Ground Fault Interrupting, Mounted High Or Above Counter Duplex Receptacle, 20A, 120V
	Mounted High Or Above Counter Duplex Receptacle, 20A, 120V
J	Junction Box, Wall Or Ceiling Mtd
or	Panel Board, Flush Or Surface Mtd
	Unfused Safety Switch - Sized Per Equipment Requirements
	Motor
	Combination Motor Starter

DCA REVIEW

ELECTRICAL ABBREVIATIONS

Identifier	Description
A	Amp(s)
AC	Alternating Current
AF	Amp Frame
AIC	Amps Interrupting Capacity (RMS Symmetrical Amperes)
AFI, AFCI	Arc Fault Current Interrupter
AT	Amp Trip
ATS	Automatic Transfer Switch
C	Conduit
CB	Circuit Breaker
CT	Current Transformer
DC	Direct Current
EMT	Electrical Metallic Tubing
EWC	Electric Water Cooler
FACP	Fire Alarm Control Panel
G, GND	Ground
GFI, GFCI	Ground Fault Circuit Interrupter
HV	High Voltage (> 69,000V)
IG	Isolated Ground
IMC	Intermediate Metal Conduit
JB, J	Junction Box
KCMIL	Thousand Circular Mil
LRA	Locked Rotor Amps
LV	Low Voltage (< 50V)
MC	Metal Clad Cable
MCB	Main Circuit Breaker
MCC	Motor Control Center
MDP	Main Distribution Panel
MDS	Main Distribution Switchboard
MLO	Main Lugs Only
MOCP	Maximum Overcurrent Protection
MV	Medium Voltage (> 600V)
N	Neutral (Grounded Circuit Conductor)
NC	Normally Closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Assoc.
NO	Normally Open
NL	Night Light
PH, ϕ	Phase
PF	Power Factor
PRI	Primary
PNL	Panel
RECEPT	Receptacle
RGS	Rigid Galvanized Steel
SEC	Secondary
SCP	Security Control Panel
STP	Shielded Twisted Pair
SWBD	Switchboard
TEL	Telephone
TBB	Telephone Backboard
TMCC	Temperature Motor Control Center
UTP	Unshielded Twisted Pair
V	Volt
VA	Volt-Ampere
VAR	Volt-Ampere Reactive
W	Watts
WP	Weatherproof
XFMR	Transformer

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project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
GENERAL INFORMATION SHEET - 2

scale	drawn by	checked by	date	filename
AS SHOWN	CAD	DR	06/09/2023	12636G102

dwg. no.
G102

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PHOTO A

Existing Hot Water Boiler, Pumps, Air Handler, Controls, And All Accessories To Be Replaced.

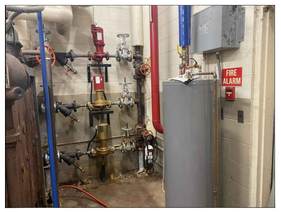

PHOTO B

Existing Inline Hot Water Pumps To Be Replaced. Existing Domestic Hot Water To Be Relocated To File Room And Be Reinstalled On New 24" High Concrete Housekeeping Pad.

PHOTO C

Existing Power And Controls For HVAC Units To Be Removed.

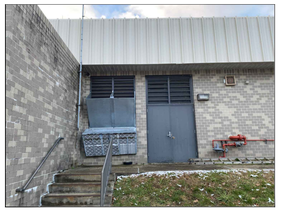

PHOTO D

Existing Louvers And Ductwork For Interior Condensing Unit To Be Removed. Portion Of Louver To Be Reused For Outside Air Intake On New Air Handler. Unused Portions To Be Sealed.

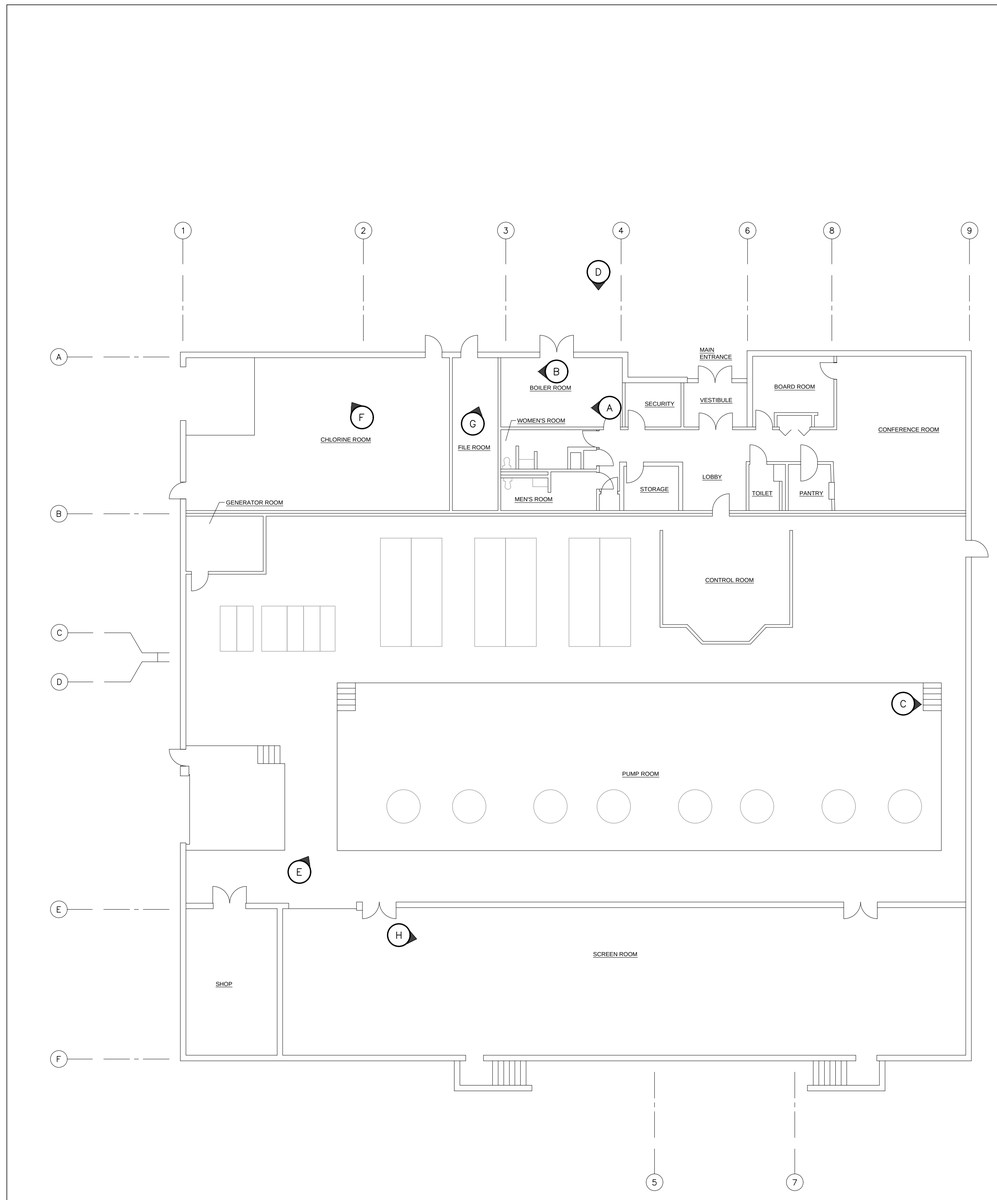

PHOTO E

Existing Heating Only Rooftop Air Handlers To Be Replaced. Existing Steel Dunnage To Remain.

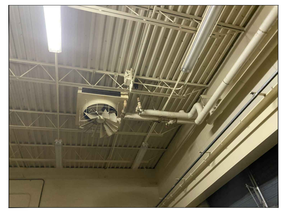

PHOTO F

Existing Vertical Hot Water Unit Heaters To Be Replaced.

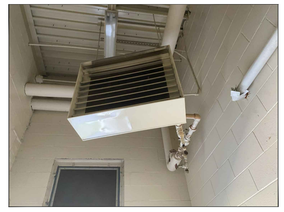

PHOTO G

Existing Horizontal Hot Water Unit Heaters To Be Replaced.

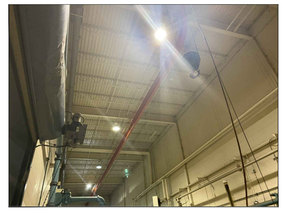

PHOTO H

Existing Screen Room Lighting To Be Replaced.

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project
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title
PHOTO OVERVIEW

scale	drawn by	checked by	date	filename
AS SHOWN	CAD	DR	06/09/2023	12636G103

dwg. no.
G103

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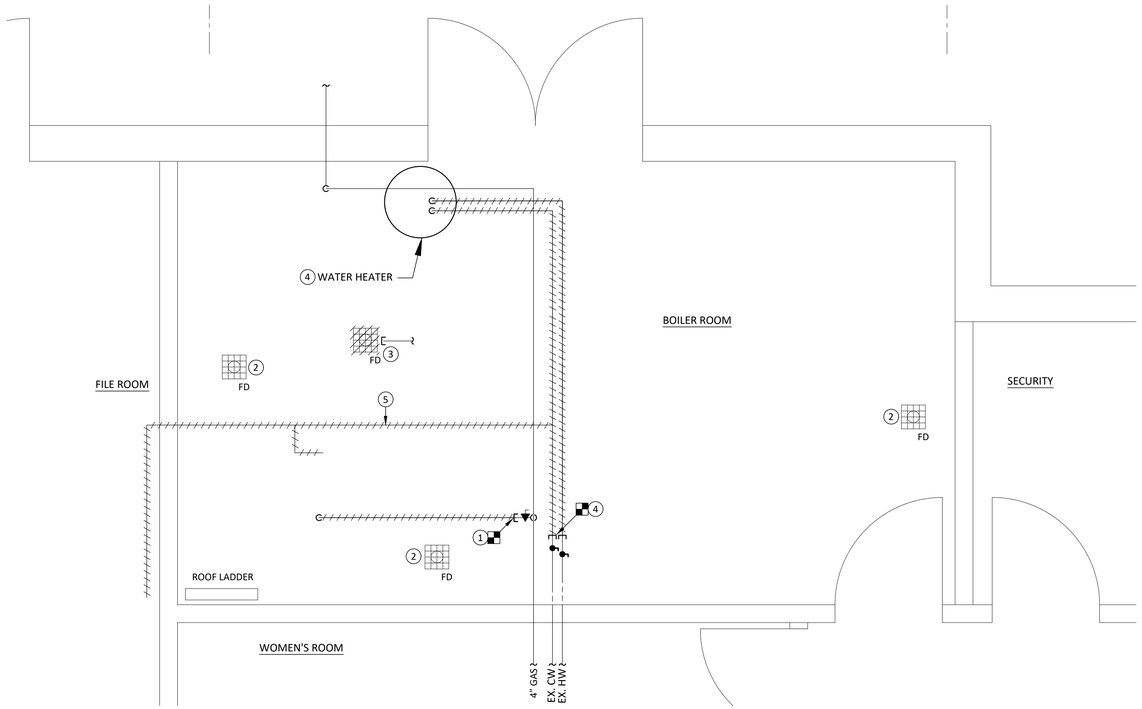


KEY NOTES (SYMBOLS 1, 2, ETC.)

1. Existing Gas Piping To Be Removed Up To Points Shown And Capped And Ready For Connection To New Equipment.
2. Existing Floor Drain To Remain. Openings Shall Be Protected During Construction. Floor Drain And Piping Shall Be Scoped And Cleaned. See Specification For Additional Information.
3. Existing Floor Drain Shall Be Removed Prior To Pouring New Equipment Pads. Existing Underfloor Sanitary Piping Shall Be Cut Back To Main And Capped.
4. Existing Water Heater To Be Relocated. Domestic Water Piping Shall Be Removed Up To Points Shown And Capped And Ready For Connection To New Location. Provide New Line Size Shutoff Valves.
5. Existing Domestic Water Piping For Expansion Tanks To Be Removed.

DCA REVIEW

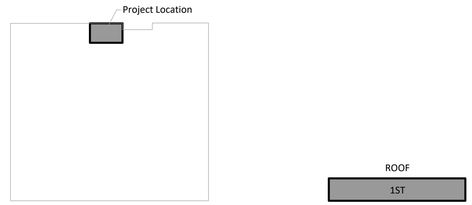
GENERAL NOTES

1. Prior To Start Of Demolition Work, The Contractor Shall Coordinate Construction Schedule With NJDWSC Engineering Staff.
2. To The Best Of Our Knowledge The Boiler Contains No Asbestos. Contractor Shall Test Boiler And Provide Reports To NJDWSC Engineering Staff Prior To Starting Demolition Work.

PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description
	Disconnect From Existing
	Existing Equipment
	Demo Equipment
	Existing Piping To Remain
	Existing Piping To Be Removed
	Pipe Riser
	Pipe Drop On Direction Of Flow
	Capped Pipe
	Ball Valve
	Automatic Air Vent With Ball Valve

Identifier	Description
CW	Cold Water
EX	Existing
HWR	Hot Water Return
HWS	Hot Water Supply
NIC	Not In Contract
M	Water Meter Assembly
	Floor Drain



KEY PLAN

VERTICAL PLAN

MECHANICAL ROOM PART PLAN

Scale: 1/2"=1'-0" (6" 1' 2' 4')

Drawing: P101
Detail: 01

REV.	DATE	ISSUE DESCRIPTION	ITEM	DATE	ISSUE DESCRIPTION
A	6/23/23	ISSUE FOR BID AND DCA REVIEW			

dlbassociates consulting engineers
3600 Route 66, Suite 150 - #5981
Neptune NJ 07753

Questions For DLB Call: Dan Rehberg
DLB Project ID: 12636 Phone: 732-318-0314

project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
PLUMBING DEMOLITION
PARTIAL PLANS

dwg. no.
P101

scale	drawn by	checked by	date	filename
AS SHOWN	CAD	DR	06/09/2023	12636P101

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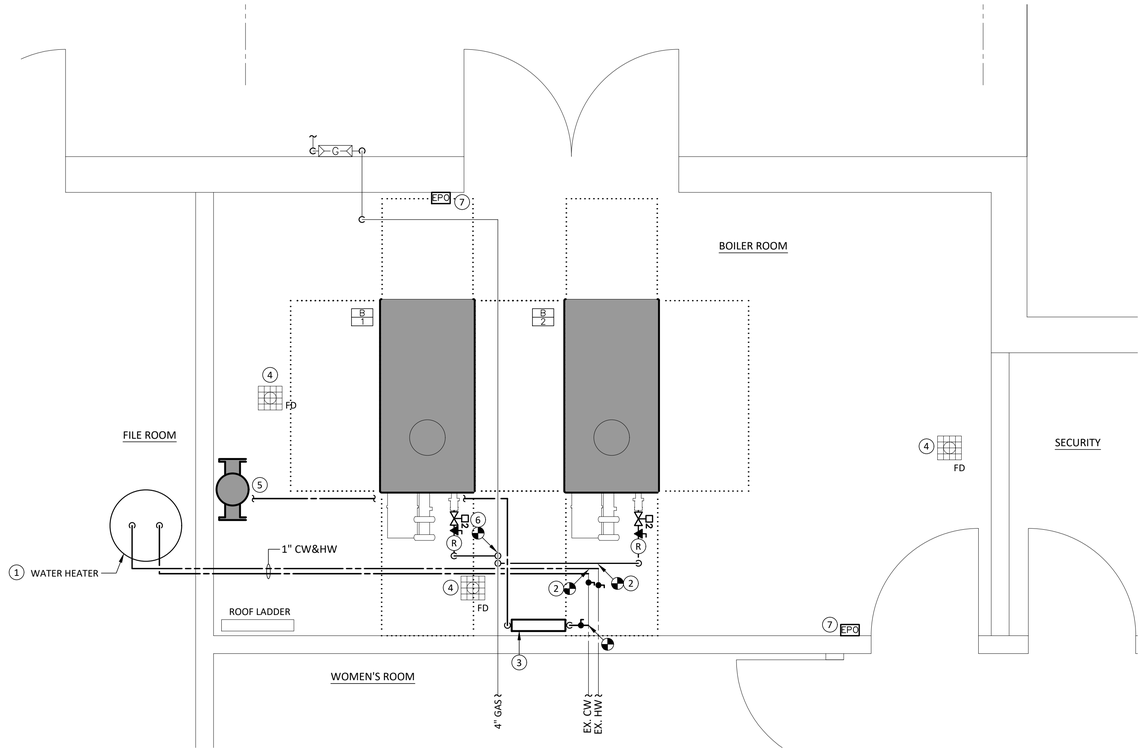


MECHANICAL ROOM PART PLAN

Scale: 1/2"=1'-0" (6" 1' 2' 4')

Drawing: P102
Detail: 01

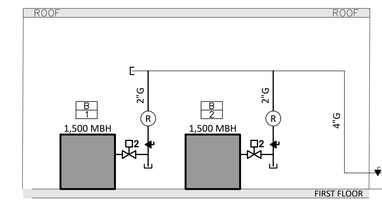
KEY NOTES (SYMBOLS 1, 2, ETC.)

1. Provide New 24" High Concrete Pad A Minimum Of 4" Around The Perimeter Of Relocated Water Heater. See Structural Plans For Additional Information.
2. Domestic Water Piping Shall Be Modified To Accommodate New Water Heater Location.
3. Provide New RPZ Assembly, Conbraco Model 40-200 Or Approved Equal. See Detail For Additional Information.
4. Existing Floor Drains Shall Be Scoped And Cleaned After Construction Is Complete.
5. Cold Water Make-up To Air Separator. See Mechanical Plans For Additional Information.
6. Provide New 2" Gas Piping To Each Boiler. Provide 1-1/2" Solenoid Valve Model WP8210 By Asco Or Approved Equal. Solenoid Valve Shall Close Upon Activation Of The EPO Switches.
7. See Electrical Plans For Additional Information On EPO Switches.

DCA REVIEW

GENERAL NOTES

1. Contractor Is Responsible For Field Verification Of All Conditions And New Piping Tie-In Locations, And Is Also Responsible For Reporting Any Conflicts To The Engineer Prior To The Start Of Work.
2. It Is The Responsibility Of The Plumbing Contractor To Verify All Equipment Connections, Based On Current Plumbing Conditions.
3. Provide Reduced Pressure Backflow Preventers At All Domestic Water Connections To Mechanical Equipment As Required By Local Code Authorizes. Backflow Preventers Are To Be Located Within A Minimum Of 1'-0" Clearance At The Lowest Point And Located No More Than 5'-0" Above Floor At The Highest Point Of The Device.
4. All Pipe Penetrations Of Fire And/ Or Smoke Rated Assemblies Shall Be Fire Stopped As Required To Restore Assembly To Original Integrity.

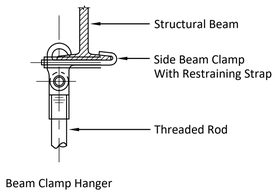


4" NATURAL GAS SUPPLY
TOTAL LOAD: 3,000 MBH
PRESSURE DROP: 0.5" W.C.
DEVELOPED LENGTH: 57 FT.
SCHEDULE 40 METALLIC PIPE
DESIGN PRESSURE: LESS THAN 2 PSI
SPECIFIC GRAVITY: 0.60
Table 402.4(2) IFGC 2021

GAS RISER DIAGRAM

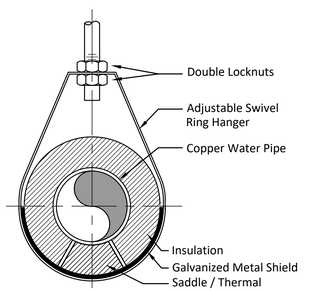
Scale: NTS

Drawing: P102
Detail: 02



Beam Clamp Hanger

Domestic Cold Water	Insulation Thickness
0 To 4 Inches	3/4 Inch
Domestic Hot Water	**Insulation Thickness**
0 To 1-1/4 Inches	1 Inch
1-1/2 To 3 Inches	1-1/2 Inches



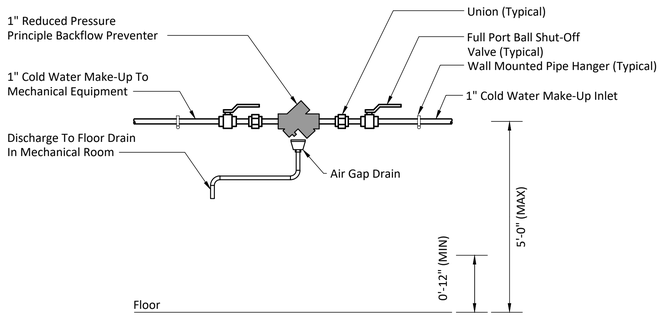
For 2" Pipe And Smaller

	Horizontal Support		Shield Data	
Pipe Size (Inches)	Spacing (Feet)	Rod Size (inches)	Length (Inches)	Thickness (USSG)
A	B	C	D	E
0 To 3/4	5	3/8	12	18
1 To 1-1/4	6	3/8	12	18
1-1/2 To 2	8	3/8	12	18
2-1/2	9	1/2	12	18
3	10	1/2	12	16
4	12	5/8	12	16

DOMESTIC WATER PIPE SUPPORTS

Scale: NTS

Drawing: P102
Detail: 03



DETAIL OF COLD WATER MAKE-UP

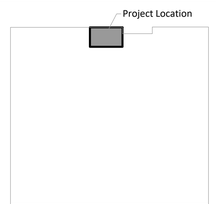
Scale: NTS

Drawing: P102
Detail: 04

PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description
	Connect To Existing
	Existing Equipment
	New Equipment
	Capped Pipe
	Ball Valve
	Pipe Drop On Direction Of Flow
	Floor Drain

Identifier	Description
CW	Cold Water
EPO	Emergency Power Off
G	Natural Gas
HW	Hot Water
NIC	Not In Contract
RPZ	Reduced Pressure Zone Assembly



KEY PLAN

VERTICAL PLAN

REV.	DATE	ISSUE DESCRIPTION	ITEM	DATE	ISSUE DESCRIPTION
A	6/23/23	ISSUE FOR BID AND DCA REVIEW			

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Questions For DLB Call: Dan Rehberg
DLB Project ID: 12636 Phone: 732-318-0314

project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
BOILER ROOM
NEW WORK PLANS

dwg. no.
P102

scale	drawn by	checked by	date	filename
AS SHOWN	CAD	DR	06/09/2023	12636P102

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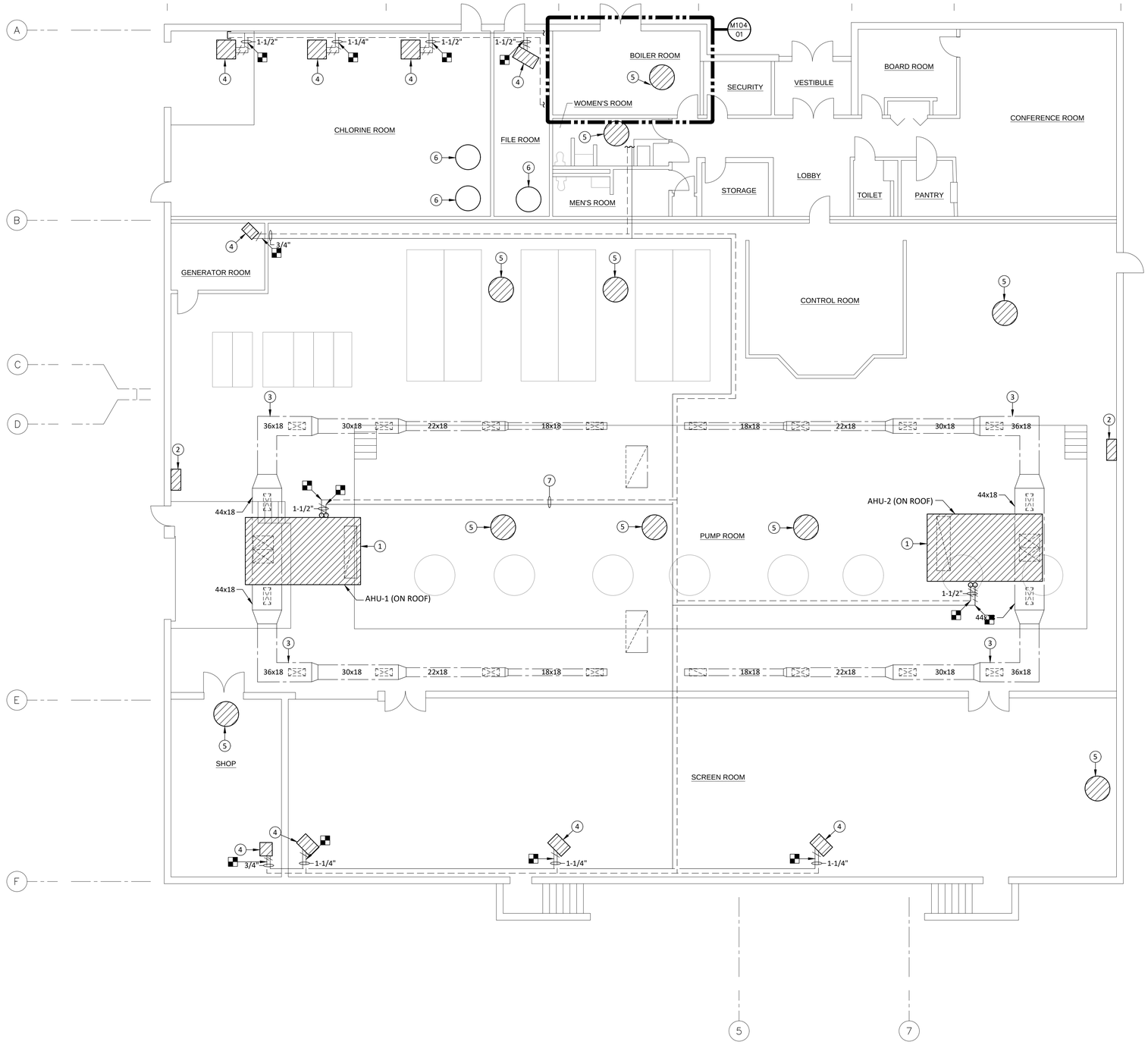


KEY NOTES (SYMBOLS 1, 2, ETC.)

1. Existing Air Handler Mounted On Roof To Be Removed. Seal Openings Weather Tight Until Ready For Installation Of New Equipment. Hot Water Piping To Be Removed Past Existing Shutoff Valves. Existing Piping To Remain To Be Capped And Ready For Connection To New Systems.
2. Existing Air Handler Control Panels To Be Removed.
3. Existing Ductwork To Remain. Provide Option Pricing To Clean Ductwork.
4. Existing Unit Heaters, Hangers, And Controls To Be Removed. Hot Water Piping To Be Removed Past Existing Shutoff Valves. Existing Piping To Remain To Be Capped And Ready For Connection To New Systems.
5. Existing Roof Mounted Exhaust Fans To Be Removed. Seal Opening Weather Tight Until Ready For Installation Of New Equipment.
6. Existing Roof Mounted Exhaust Fans To Remain.
7. Existing Hot Water Supply And Return Piping, Insulation, And Hangers To Remain.

DCA REVIEW

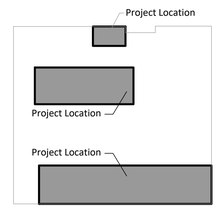
GENERAL NOTES

1. Prior To Start Of Demolition Work, The Contractor Shall Coordinate Construction Schedule With NJDWSC Engineering Staff.

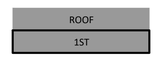
PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description
	Disconnect From Existing
	Existing Equipment
	Demo Equipment
	Existing Piping To Remain
	Existing Piping To Be Removed

Identifier	Description
EX	Existing
HWR	Hot Water Return
HWS	Hot Water Supply
NIC	Not In Contract



KEY PLAN



VERTICAL PLAN

FLOOR PLAN Scale: 1/8"=1'-0" (2' 4' 8' 16')

Drawing: **M101**
Detail: **01**

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Questions For DLB Call: **Dan Rehberg**
DLB Project ID: 12636 Phone: 732-318-0314

project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
BUILDING OVERVIEW
DEMOLITION PLAN

dwg. no.
M101

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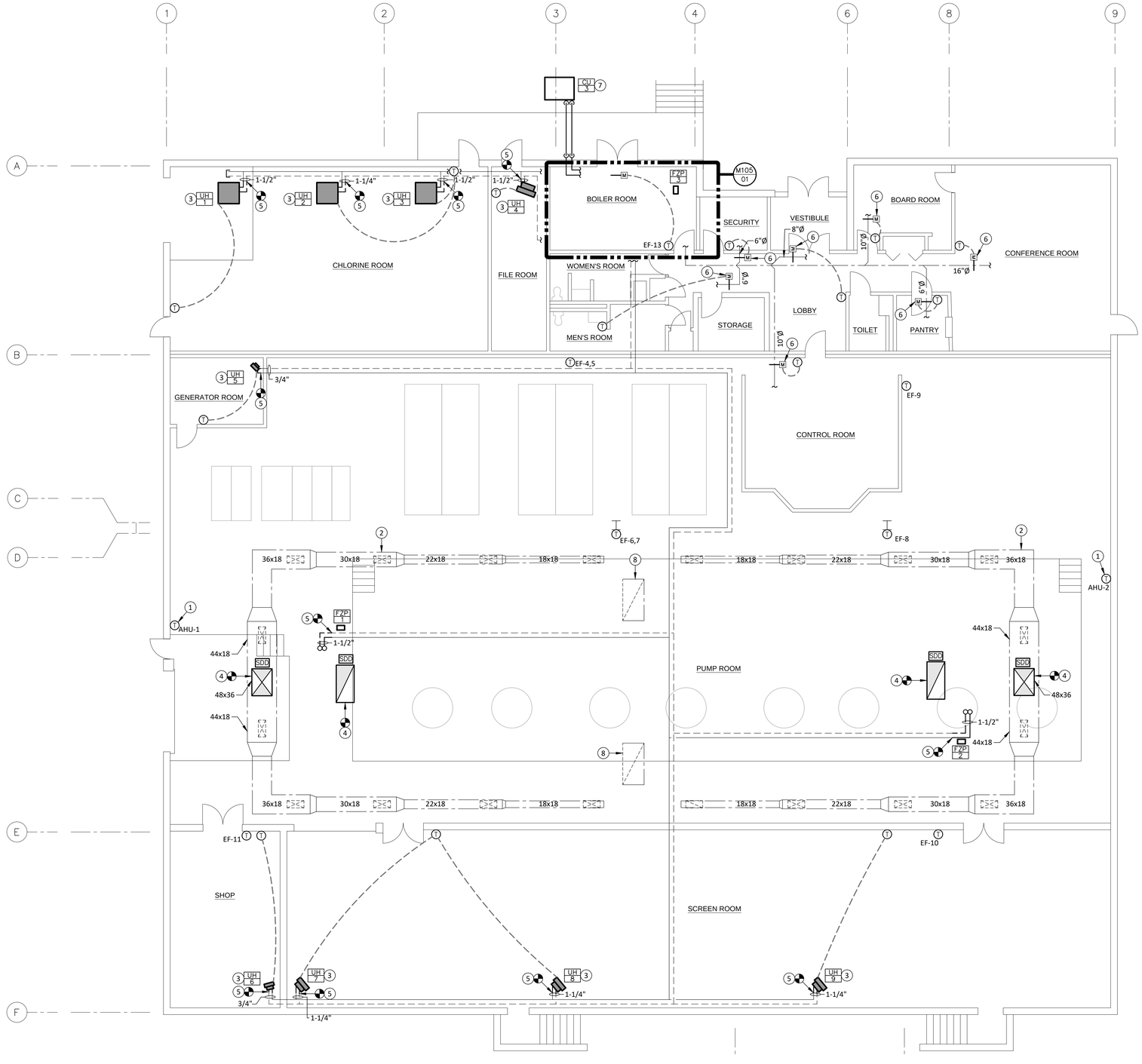

KEY NOTES (SYMBOLS 1, 2, ETC.)

1. Graphical Touchscreen With Programmable Thermostat To Provide Weekly Occupied / Unoccupied Scheduling And Interface With All Unit Controls. Coordinate Final Mounting Location With Owner Prior To Installation.
2. Existing Ductwork To Remain. Provide Option Pricing To Clean Ductwork.
3. New Unit Heater. See Details For Mounting And Hot Water Piping Connections.
4. Connect Ductwork In Pump Room To New Ductwork From New Rooftop Air Handlers. Provide Wire Mesh Screen On Return.
5. Connect Hot Water Piping And Insulation To Existing Systems. Provide All Accessories Per Detail.
6. Provide New Motorized Damper And Connect To Existing Ductwork.
7. Install New Condensing Unit On New Steel Platform. See Structural Plan For Additional Information. Refrigerant Piping Shall Be Routed Over Sidewalk A Minimum Of 8'-0" Above Grade.
8. Existing Relief Louver To Remain.

DCA REVIEW

GENERAL NOTES

1. Make All Necessary Duct Connections To HVAC Units, Exhaust Fans, Exhaust Hoods, Etc.
2. Contractor Shall Verify All Specific Manufacturer Requirements For All Equipment Prior To Installation.
3. All Roof Mounted Equipment, Unless Otherwise Noted, Shall Be Curb Mounted And Must Be Installed Level. Verify Roof Pitch With Architectural Drawings.
4. All Roof Mounted Equipment Shall Be Located As To Be In Compliance With All Local Sight And Sound Restrictions.
5. All Exhaust Fans, Flues And Outlets Shall Be Located A Minimum Of 10'-0" From Any Fresh Air Intake.
6. All Space & Duct Temperature/Humidity Sensors Are To Be Provided, And Installed By Mechanical Contractor. Electrical Contractor To Wire Controls, Mechanical Contractor To Wire All Final Connections.
5. Mechanical Contractor Is Responsible For Coordinating With Fire Protection, Plumbing And Electrical Conditions For Duct Routing.
6. Each Contractor Shall Be Responsible For All Cutting And Patching Of Walls, Ceilings, And Floors Required As A Result Of His Work.
7. Each Contractor Shall Be Responsible For All Preparation And Clean-Up Work Associated With His Scope Of Work.
8. Ductwork Shall Be Constructed In Accordance With SMACNA Low And Medium Pressure "HVAC" Duct Construction Standards Metal And Flexible.
9. Duct Sizes Shown Are Clear Inside Dimensions. Internally Lined Ducts Shall Be Increased In Size To Maintain The Same Internal Size.
10. Provide Double Thickness Turning Vanes In All Square Elbows.

PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description
	Connect To Existing
	Existing Equipment
	New Equipment On Roof
	New Equipment
T	Thermostat
	Existing Ductwork

Identifier	Description
AHU	Air Handling Unit
SDD	Smoke Duct Detector
UH	Unit Heater

KEY PLAN

VERTICAL PLAN

FLOOR PLAN

Scale: 1/8"=1'-0"

2' 4' 8' 16'

Drawing: **M102**
Detail: **01**

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DLB Project ID: 12636 Phone: 732-318-0314

project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
BUILDING OVERVIEW
NEW WORK PLAN

dwg. no.
M102

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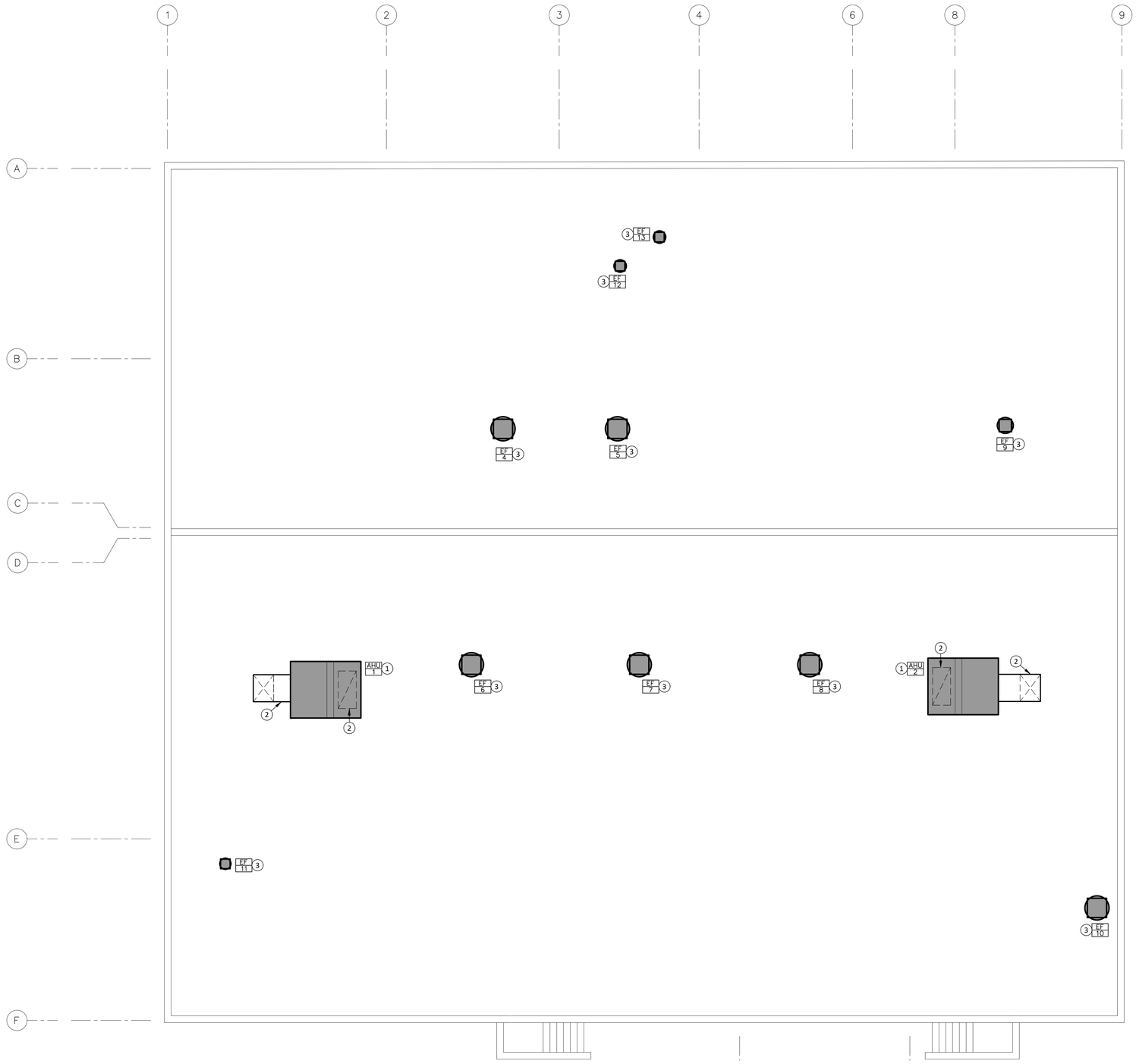


ROOF PLAN

Scale: 1/8"=1'-0"

2' 4' 8' 16'

Drawing: **M103**

Detail: **01**

KEY NOTES (SYMBOLS 1, 2, ETC.)

1. Air Handler Mounted On Roof. See Structural Plans For Modifications To Existing Steel.
2. Transition New Ductwork To Drop Through Existing Opening And Connect To Ductwork In Pump Room.
3. New Roof Mounted Exhaust Fan. Install On Existing Curb With Adaptor.

DCA REVIEW

GENERAL NOTES

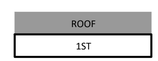
1. Make All Necessary Duct Connections To HVAC Units, Exhaust Fans, Exhaust Hoods, Etc.
2. Contractor Shall Verify All Specific Manufacturer Requirements For All Equipment Prior To Installation.
3. All Roof Mounted Equipment, Unless Otherwise Noted, Shall Be Curb Mounted And Must Be Installed Level. Verify Roof Pitch With Field Conditions.
4. All Roof Mounted Equipment Shall Be Located As To Be In Compliance With All Local Sight And Sound Restrictions.
5. All Exhaust Fans, Flues And Outlets Shall Be Located A Minimum Of 10'-0" From Any Fresh Air Intake.
6. All Space & Duct Temperature/Humidity Sensors Are To Be Provided, And Installed By Mechanical Contractor. Electrical Contractor To Wire Controls, Mechanical Contractor To Wire All Final Connections.
5. Mechanical Contractor Is Responsible For Coordinating With Fire Protection, Plumbing And Electrical Conditions For Duct Routing.
6. Each Contractor Shall Be Responsible For All Cutting And Patching Of Walls, Ceilings, And Floors Required As A Result Of His Work. All Work On Roof Shall Be Repaired To Like New Conditions.
7. Each Contractor Shall Be Responsible For All Preparation And Clean-Up Work Associated With His Scope Of Work.
8. Ductwork Shall Be Constructed In Accordance With SMACNA Low And Medium Pressure "HVAC" Duct Construction Standards Metal And Flexible.
9. Duct Sizes Shown Are Clear Inside Dimensions. Internally Lined Ducts Shall Be Increased In Size To Maintain The Same Internal Size.
10. Provide Double Thickness Turning Vanes In All Square Elbows.

PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description
	Connect To Existing
	Existing Equipment
	New Equipment On Roof
	New Equipment
T	Thermostat
	Existing Ductwork

Identifier	Description
AB	Air Blower
AHU	Air Handling Unit
UH	Unit Heater

KEY PLAN



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project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
BUILDING OVERVIEW
NEW WORK ROOF PLAN

dwg. no.
M103

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AS SHOWN	CAD	DR	06/09/2023	12636M103

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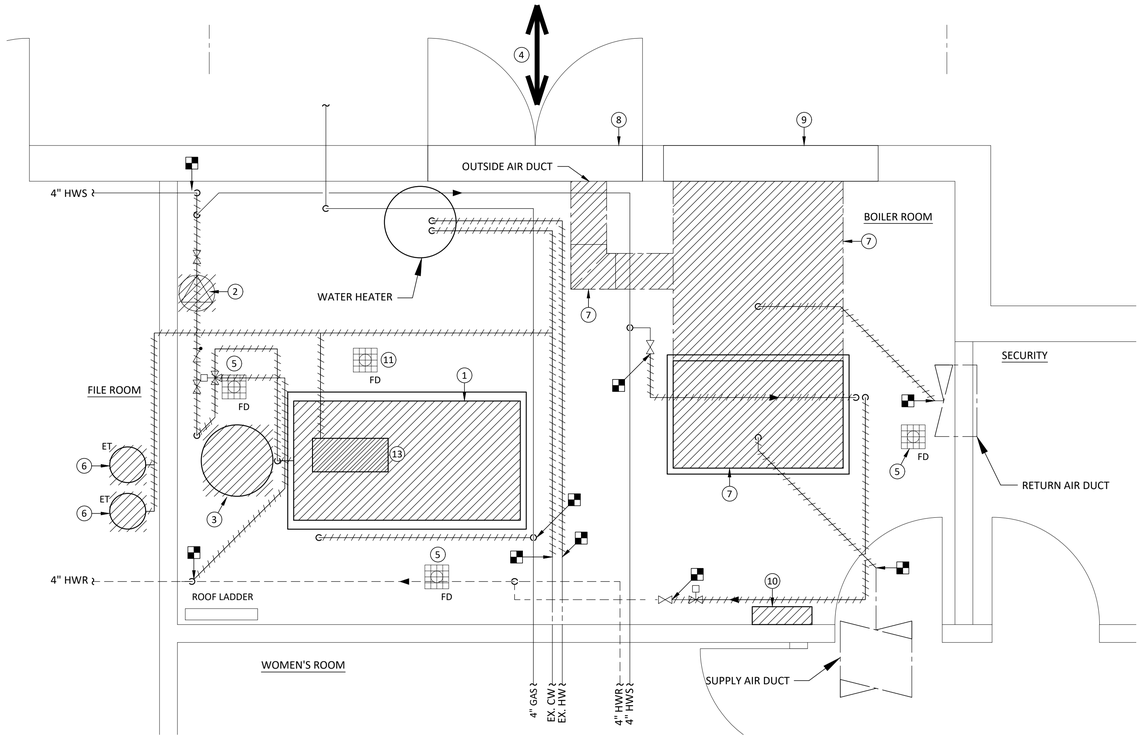
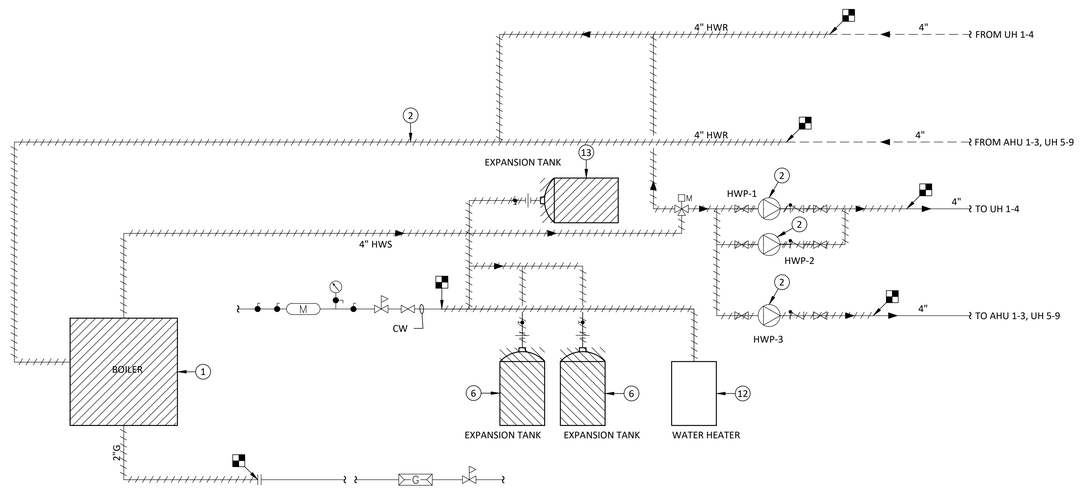


MECHANICAL ROOM PART PLAN | Scale: 1/2"=1'-0" | Drawing: **M104** | Detail: **01**



FLOW DIAGRAM | Scale: NTS | Drawing: **M104** | Detail: **02**

KEY NOTES (SYMBOLS 1, 2, ETC.)

1. Existing Boiler And All Hot Water, Gas, Breeching, And Electrical Connections To Be Removed Up To Points Shown. Existing Pad Shall Be Removed Down To Floor Level. Self Leveling Concrete Shall Be Used To Match Existing Floor Level.
2. Existing Pumps, Expansion Tank, Supports, And Hot Water Piping To Be Removed Up To Points Shown. Existing Piping To Remain To Be Capped And Ready For Connection To New Systems.
3. Existing Breeching Shall Be Removed Completely Up To, And Including, Cap On Roof. Openings Shall Be Sealed Weather Tight Until Ready For Installation Of New Breeching.
4. Proposed Rigging Pathway. Any Modifications To Existing Doors Required For Rigging Shall Be Repaired To Like New Condition.
5. Existing Floor Drain To Remain. Openings Shall Be Protected During Construction. Floor Drain And Piping Shall Be Scoped And Cleaned.
6. Existing Expansion Tanks Located In File Room To Be Removed. Domestic Cold Water Piping To Be Removed Up To Points Shown. Existing Piping To Remain To Be Capped And Ready For Connection To New Systems.
7. Existing Air Handler, Ductwork, And Louvers To Be Removed. Existing Pad Shall Be Removed Down To Floor Level. Self Leveling Concrete Shall Be Used To Match Existing Floor Level.
8. Existing Outside Air Louver Shall Remain. Louver Shall Be Cleaned After Demolition Work Is Completed.
9. Existing Condenser Intake And Discharge Ductwork And All Filters And Ductwork On Building Exterior To Be Removed. Existing Upper 72" Wide x 36" High Louver Shall Remain And Be Cleaned After Demolition Work Is Completed. Remaining Louver Sections Shall Be Removed And Opening Closed Up With Brick To Match Existing Conditions.
10. Existing Air Handler Control Panel And All Wiring To Be Removed.
11. Existing Floor Drain Shall Be Closed And Sealed Prior To Pouring New Equipment Pads.
12. Existing Water Heater To Be Relocated. Domestic Water Piping Shall Be Removed Up To Points Shown And Capped And Ready For Connection To New Location.
13. Existing Ceiling Mounted Expansion Tank And All Supports To Be Removed. Domestic Cold Water Piping And Accessories To Be Removed Up To Points Shown. Existing Piping To Remain To Be Capped And Ready For Connection To New Systems.

DCA REVIEW

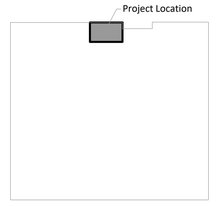
GENERAL NOTES

1. Prior To Start Of Demolition Work, The Contractor Shall Coordinate Construction Schedule With NJDWSC Engineering Staff.
2. Contractor Shall Test Boiler For Hazardous Materials And Provide Reports To NJDWSC Engineering Staff Prior To Starting Demolition Work.

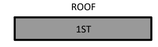
PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description
	Disconnect From Existing
	Existing Equipment
	Demo Equipment
	Existing Piping To Remain
	Existing Piping To Be Removed
	Pipe Riser
	Pipe Drop On Direction Of Flow
	Capped Pipe
	Ball Valve

Identifier	Description
CW	Cold Water
ET	Expansion Tank
EX	Existing
HWR	Hot Water Return
HWS	Hot Water Supply
NIC	Not In Contract
	Floor Drain



KEY PLAN



VERTICAL PLAN

REV.	DATE	ISSUE DESCRIPTION	ITEM	DATE	ISSUE DESCRIPTION
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dlbassociates consulting engineers
3600 Route 66, Suite 150 - #5981
Neptune NJ 07753
Questions For DLB Call: Dan Rehberg
DLB Project ID: 12636 Phone: 732-318-0314

project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
MECHANICAL DEMOLITION
PARTIAL PLANS

scale	drawn by	checked by	date	filename
AS SHOWN	CAD	DR	06/09/2023	12636M104

dwg. no. M104

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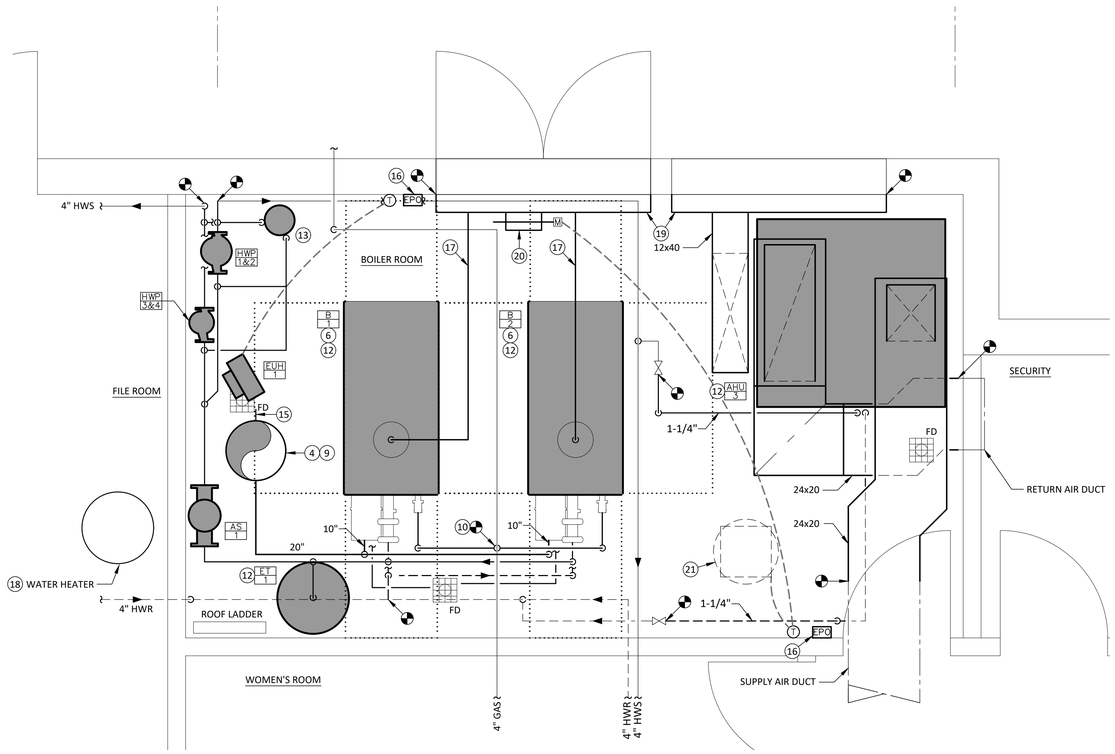
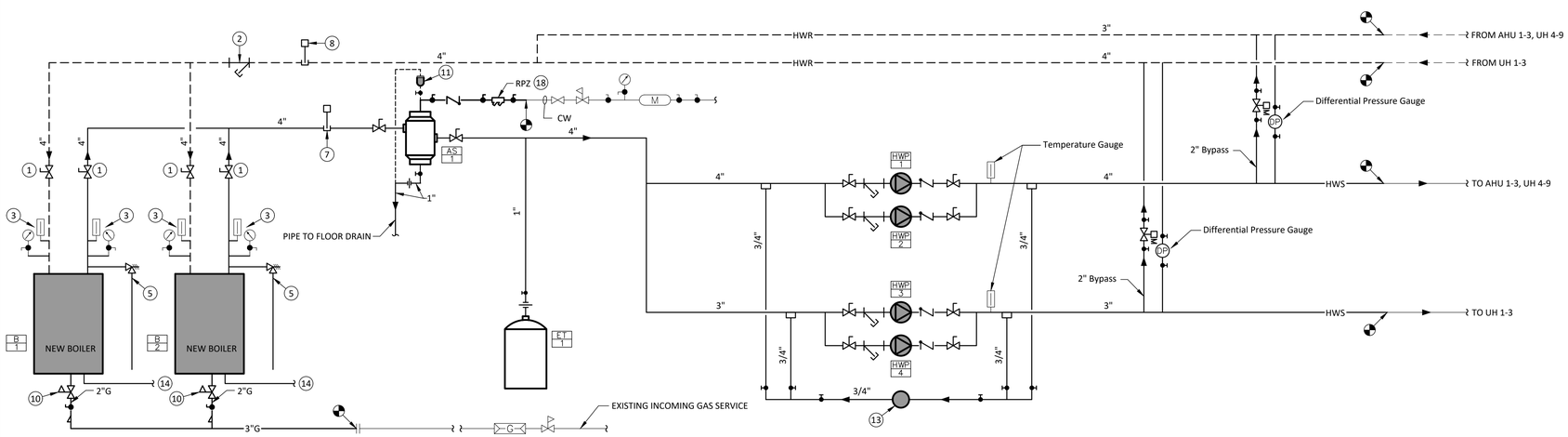


MECHANICAL ROOM PART PLAN — Scale: 1/2"=1'-0" (6" 1' 2' 4') — Drawing: **M105** Detail: **01**



FLOW DIAGRAM — Scale: NTS — Drawing: **M105** Detail: **02**

KEY NOTES (SYMBOLS 1, 2, ETC.)

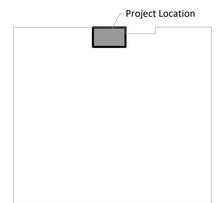
1. Provide Line Size Lug Type Butterfly Isolation Valve. Valve Shall Be Installed So That The Valve Is Parallel To The Fluid Flow And As Close To The Main As Possible. All Manual Operators Higher Than 7'-0" AFF Shall Be Equipped With Chain Wheels And Chains.
2. Provide Line Size Wye Strainer With Blow-Off Valve, Hose Bib Connection, And Cap.
3. Provide Thermometer And Pressure Gage With Pet Cock.
4. Install New Breeching. Insert New Breeching Through Existing Opening To Roof And Seal Roof Opening Perimeter Airtight.
5. Provide Pressure Relief Valve Sized In Accordance With Manufacturers Recommendations And Rated At 60PSI. Route Relief Valve Drain To 6" AFF. In A Manner To Not Create A Tripping Hazard, Drain Line Should Be Installed Immediately Adjacent To Boiler Equipment Pad Where Possible.
6. Provide New Boiler Mounted Control Panel. Connect Hot Water Supply Temperature Transmitter, Boiler, Pumps, And Outside Air Temperature Transmitter.
7. Locate Hot Water Supply Temperature Transmitter (0-250F Range With 4-20mA Communication) 2 To 10 Pipe Diameters After The Last Boiler Supply Piping Fitting.
8. Locate Hot Water Return Temperature Transmitter (0-250F Range With 4-20mA Communication) 2 to 10 Pipe Diameters After The Return Header Piping Tap. Connect To Boiler Control Panel.
9. New 20" Inner Diameter, Double Wall, Stainless Steel, Category IV, AL294C Breeching. Refer To Specification. The Breeching Shall Pitch Down Toward The Boiler Room At A Minimum Of 1/4" Per Foot. Provide Manufacturer's Engineered Supports To Support Breeching. No Breeching Weight Shall Rest On Boiler Connection. Provide Damper With Low-Voltage Actuator And Draft Controller At Boiler To Maintain Negative Pressure In Stack. Contractor To Provide To-Scale Drawings To Breeching Manufacturer Who Shall Calculate Required Sizing. Contractor Is Responsible For Providing And Installing Required Size. Provide Temperature Gauge On Flue. Provide 1" Breeching Condensate Drain With Neutralizing Kit And Terminate At Floor Drain. Coordinate Placement With Owner In Field.
10. New Gas Regulator, Associated Shut-Off Valve And Vent Piping. Individually Pipe Gas Vents To Exterior. Terminate Minimum 10'-0" Above Path Of Egress. See Plumbing Plans For Additional Information.
11. High Capacity Automatic Air Vent.
12. Provide New 24" High Concrete Pad A Minimum Of 4" Around The Perimeter Of New Equipment. See Structural Plan For Additional Information.
13. Vector Industries Chemical Pot Feeder Model EC-5TC, Capacity 5 Gallons, 300 PSI With Filter.
14. Provide Factory Condensate Drain Kit With Neutralization Fill, Route Drain Piping To Nearest Floor Drain, And Terminate With Air Gap.
15. Provide Drain At Bottom Of New Stack. Connect To 1" Drain Piping And Provide With Neutralizing Kit.
16. Boiler Emergency Power Off Switch. Refer To Electrical Drawings For Additional Information.
17. New 12" Combustion Air Intake Directly Piped To Boiler From Existing Outside Air Louver.
18. See Plumbing Plans For Information On Water Heater And RPZ Installations.
19. Provide New 72" Wide x 42" High Insulated Plenum Behind Existing Louver. Connect New Ductwork To Plenum And Blank Off Unused Portions Of Louver.
20. Provide 12"x12" Intake Duct With Motorized Damper. See Controls Plans For Additional Information.
21. Exhaust Fan On Roof. See Plan M103 And Details For Additional Information.

DCA REVIEW

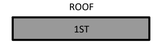
PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description
	Connect To Existing
	Existing Equipment
	New Equipment
HWS / HWR	Heating Water Supply / Return
	Shutoff Valve
2	Two-Way Valve
	Globe Valve
	Balancing Valve

Identifier	Description
CW	Cold Water
NIC	Not In Contract
RPZ	Reduced Pressure Zone Assembly
	Capped Pipe
	Ball Valve
	Pipe Drop On Direction Of Flow
	Floor Drain



KEY PLAN



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project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
BOILER ROOM
NEW WORK PLANS

dwg. no.
M105

scale	drawn by	checked by	date	filename
AS SHOWN	CAD	DR	06/09/2023	12636M105

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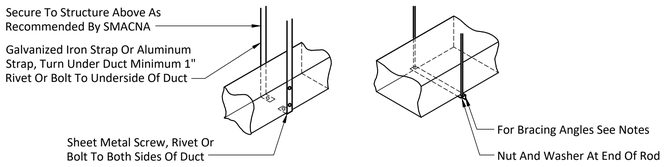
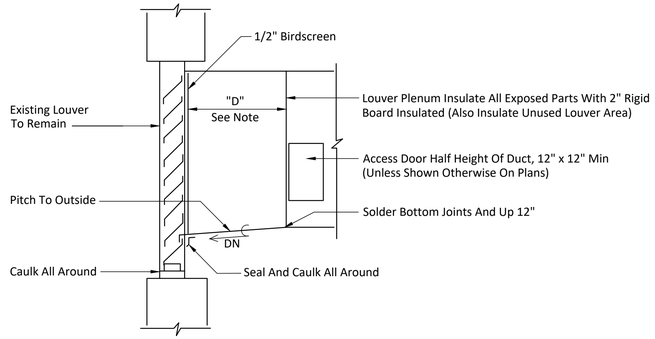
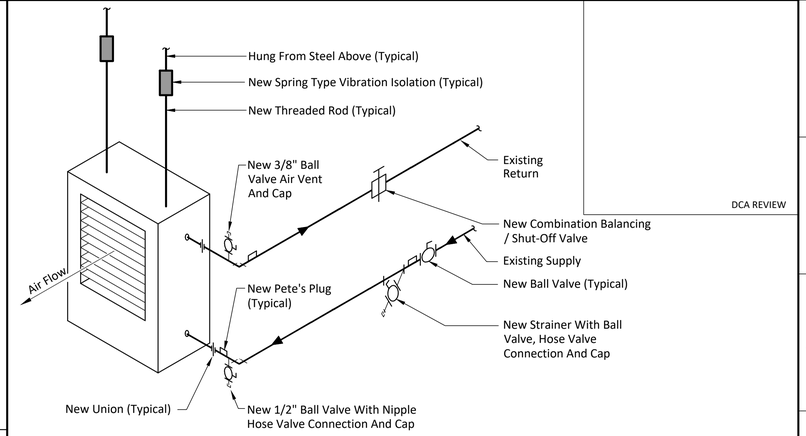
Rectangular Duct Hanger Schedule (Minimum Sizes)								
Half Duct Perimeter Range	Pair At 10' Spacing		Pair At 8' Spacing		Pair At 5' Spacing		Pair At 4' Spacing	
	Strap	Wire / Rod	Strap	Wire / Rod	Strap	Wire / Rod	Strap	Wire / Rod
P/2 < 30"	1" x 22 GA.	10 GA.	1" x 22 GA.	10 GA.	1" x 22 GA.	12 GA.	1" x 22 GA.	12 GA.
P/2 < 72"	1" x 18 GA.	3/8"	1" x 20 GA.	1/4"	1" x 22 GA.	1/4"	1" x 22 GA.	1/4"
P/2 < 96"	1" x 16 GA.	3/8"	1" x 18 GA.	3/8"	1" x 20 GA.	3/8"	1" x 22 GA.	1/4"
P/2 < 120"	1-1/2" x 16 GA.	1/2"	1" x 16 GA.	3/8"	1" x 18 GA.	3/8"	1" x 20 GA.	1/4"
P/2 < 168"	1-1/2" x 16 GA.	1/2"	1" x 16 GA.	1/2"	1" x 16 GA.	3/8"	1" x 18 GA.	3/8"
P/2 < 192"	-	1/2"	1-1/2" x 16 GA.	1/2"	1" x 16 GA.	3/8"	1" x 16 GA.	3/8"



DUCT STRAP HANGER DETAIL | Scale: NTS | Drawing: M201 | Detail: 01



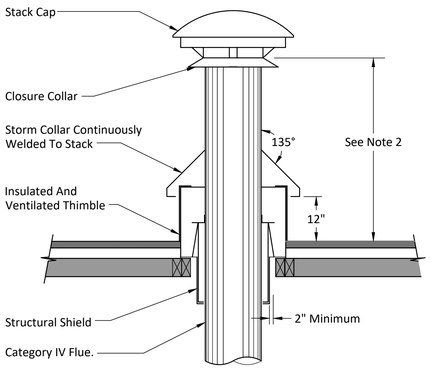
LOUVER CONNECTION DETAIL | Scale: NTS | Drawing: M201 | Detail: 02



DCA REVIEW

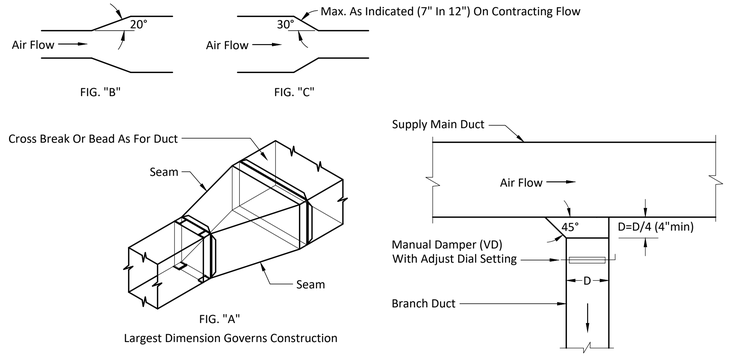
NOTES:
1. Supply And Return Connections To Have Three Changes In Direction Between Header And Mains To Provide Flexibility.

HOT WATER UNIT HEATER DETAIL | Scale: NTS | Drawing: M201 | Detail: 03



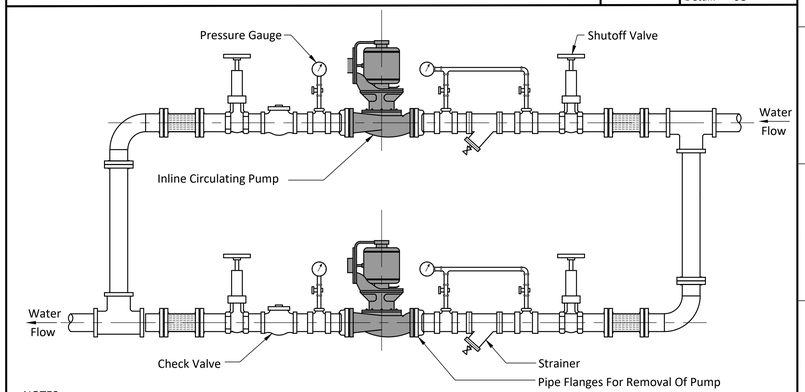
NOTES:
1. All Minimum Metal Gauges To Meet Requirements Of Local Code Or AHJ.
2. Flue Height Minimum 8'-0" Above Roof Or As Required By Local Codes. Provide Guy Wires Attached To Roof.
3. Contractor Shall Be Responsible To Remove Existing Roofing Where New Penetrations Through The Roof Occur. Contractor Shall Be Responsible To Cut New Roof Openings For New Flue. Provide New Roof Flashing And Counter Flashing. The Contractor Shall Hire The Services Of The Roofing Contractor Responsible For The Existing Roof Warranty And Guarantees, To Install All Penetrations So Not To Void Roof Warranty And Guarantees. Coordinate The Above With The Owner And The Engineer.

FLUE THROUGH ROOF DETAIL | Scale: NTS | Drawing: M201 | Detail: 04



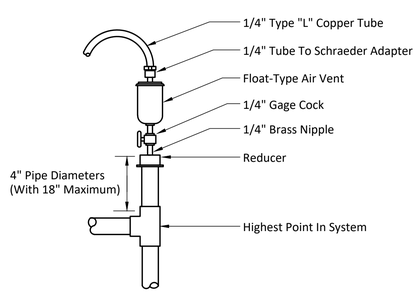
NOTES:
1. Duct Transitions Typical After Each Take-Off(s) Where Change In Duct Size Is Indicated.

DUCT TRANSITION DETAILS | Scale: NTS | Drawing: M201 | Detail: 05



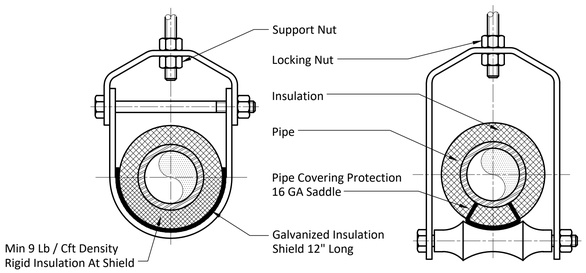
NOTES:
1. Shut-Off Cock Gauge To Be Left Shut Off Except When Actually Checking System Pressure.
2. Provide Reducers / Increasers As Required.

INLINE PUMP AND PIPING DETAIL | Scale: NTS | Drawing: M201 | Detail: 06



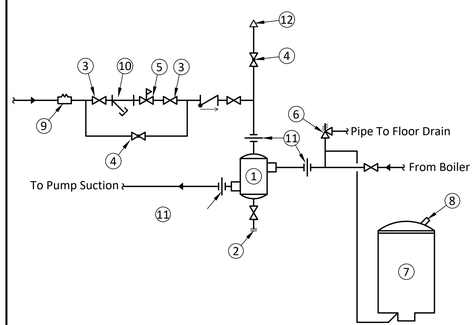
NOTES:
1. Use TFE Tape On All Threaded Joints.

AUTOMATIC AIR VENT ASSEMBLY | Scale: NTS | Drawing: M201 | Detail: 07



NOTES:
1. Threaded Rod Size Determined By Supported Weight. See Specifications For Hanger Sizes And Spacing.

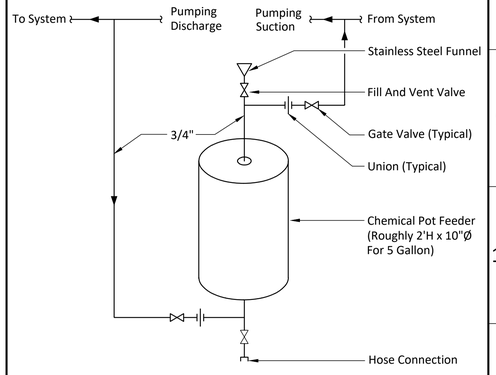
PIPE HANGER SUPPORT | Scale: NTS | Drawing: M201 | Detail: 08



EXPANSION TANK AND AIR SEPARATION DETAIL | Scale: NTS | Drawing: M201 | Detail: 09

KEY NOTES FOR DETAIL (SYMBOLS (1), (2), ETC.)

1. Air Separator
2. Blowdown With Hose End
3. Shut-Off Valve
4. Ball Valve - Normally Closed
5. Pressure Reducing Valve
6. Pressure Relief Valve
7. Expansion Tank
8. Air Charger
9. Backflow Preventer
10. Wye Strainer With Blowdown
11. Union
12. Automatic Air Vent
13. Metal Seated Check Valve
14. Standard Check Valve



NOTES:
1. Pot Feeder Shall Be Econo Series Model EC-5 With Filter By Vector Industries.

CHEMICAL POT FEEDER DETAIL | Scale: NTS | Drawing: M201 | Detail: 10

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DLB Project ID: 12636 Phone: 732-318-0314

project: NJDWSC WANAQUE SOUTH HVAC & LIGHTING REPLACEMENT 310 FAIRFIELD ROAD WAYNE, NJ 07470

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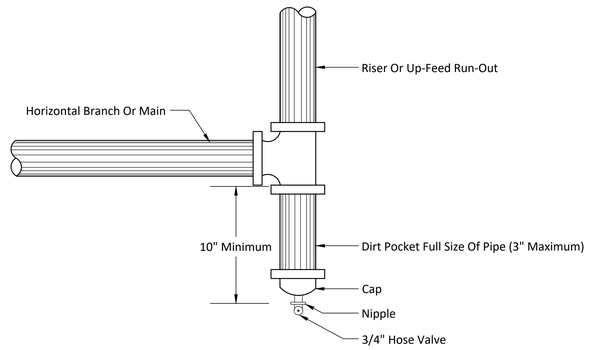
ROOM VENTILATION SCHEDULE

UNIT ID	ROOM NAME	RP (OA CFM / PERSON)	PZ (PEOPLE QTY.)	RA (OA CFM / SQFT)	AZ (AREA) (SQFT)	VBZ (CFM)	EZ	VOZ (CFM)	VPZ (MIN CFM)	ZP	NOTES
AHU-1&2	Pump Room	0	0	0.06	9,000	540	0.8	675	20,400		
	SUMMARY									VOZ = VOT =	675 CFM
										DESIGN OA =	1,000 CFM
AHU-3	Conference Room	5	6	0.06	637	68	0.8	85	1,500	0.06	
	Board Room	5	4	0.06	165	30	0.8	37	540	0.07	
	Pantry	5	1	0.06	64	9	0.8	11	170	0.07	
	Lobby	5	1	0.06	357	26	0.8	33	530	0.06	
	Security	5	1	0.06	79	10	0.8	12	160	0.08	
	Control Room	5	1	0.06	474	33	0.8	42	680	0.06	
							0.8				
	SUMMARY	PZ = 14	EV = 1.00	PS = 4	D = 0.29			ZP = 0.08	VOU = 127	VOT =	127 CFM
										DESIGN OA =	400 CFM

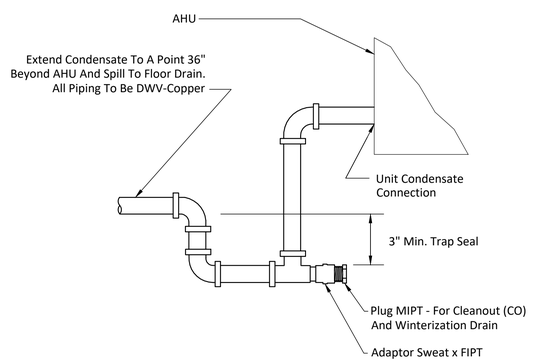
NOTES:
1. From 2021 International Mechanical Code & ASHRAE 62.1-2022, Section 403.

LEGEND:
- RP = People Outdoor Air Rate: Outdoor Airflow Rate Required Per Person
- PZ = Zone Population: Number Of People In The Space Or Spaces In The Zone
- RA = Area Outdoor Air Rate: Outdoor Airflow Rate Required Per Unit Area
- AZ = Zone Floor Area: Net Occupiable Floor Area Of The Space Or Spaces In The Zone
- VBZ = Breathing Zone Outdoor Airflow = [Rp X Pz] + [Ra X Az]
- EZ = Zone Air Distribution Effectiveness: From Table
- VOZ = Zone Outdoor Airflow Rate = Vbz / Ez
- VPZ = Primary Airflow: Lowest Expected Primary Airflow To The Zone When Fully Occupied
- ZP = Primary Outdoor Air Fraction = Voz / Vpz
- EV = System Ventilation Effectivenes
- PS = System Population: Total Number Of Occupants In The Area Served By System
- D = Occupant Diversity = Ps / Σpz
- VOU = Uncorrected Outdoor Air = [D X Σ[Rp X Pz]] + Σ[Ra X Az]
- VOT = Corrected Outdoor Air = Vou / Ev
- OA = Outdoor Air



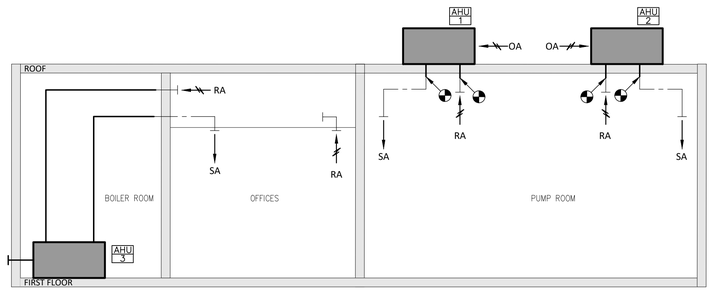
NOTES:
1. Pipe Is Welded Or Screwed As Required Per Specification.

DRAIN VALVE ARRANGEMENT AT BOTTOM OF RISERS | Scale: NTS | Drawing: **M202** Detail: **03**

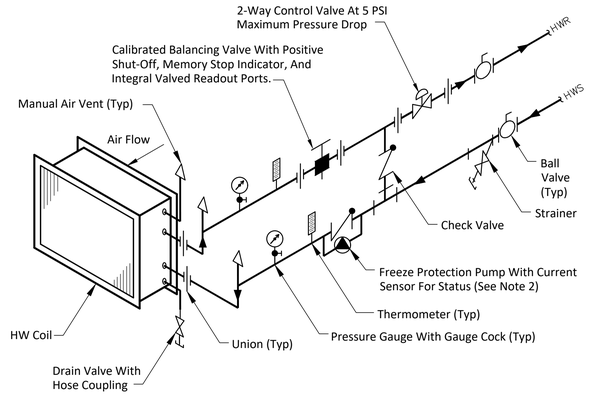


NOTES:
1. Trap Depth Must Exceed Static Pressure Of Fan. Check With Manufacturer Prior To Installing Trap.

CONDENSATE DRAIN CONNECTION | Scale: NTS | Drawing: **M202** Detail: **06**

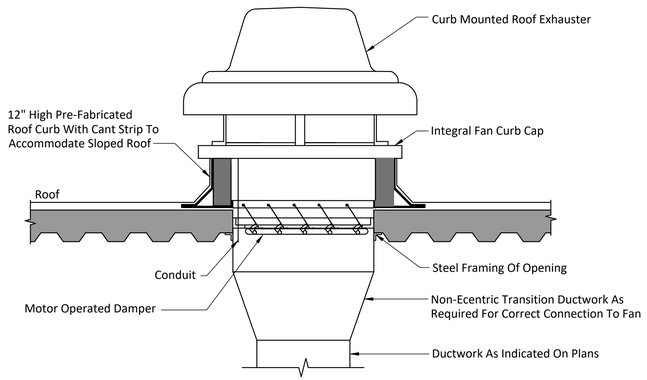


AIRFLOW RISER DIAGRAM | Scale: NTS | Drawing: **M202** Detail: **01**



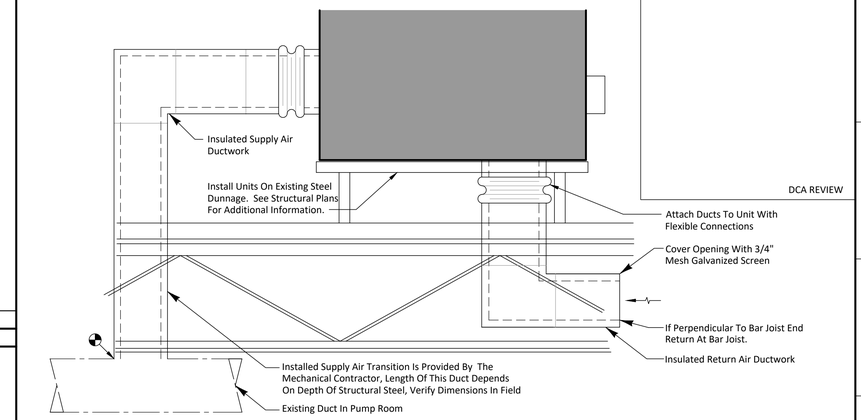
NOTES:
1. Freeze Protection Pump Shall Run When The Outside Air Temperature Is Below 45F Or The Low-Limit Switch Has Been Tripped.

HOT WATER COIL PIPING CONNECTIONS | Scale: NTS | Drawing: **M202** Detail: **04**

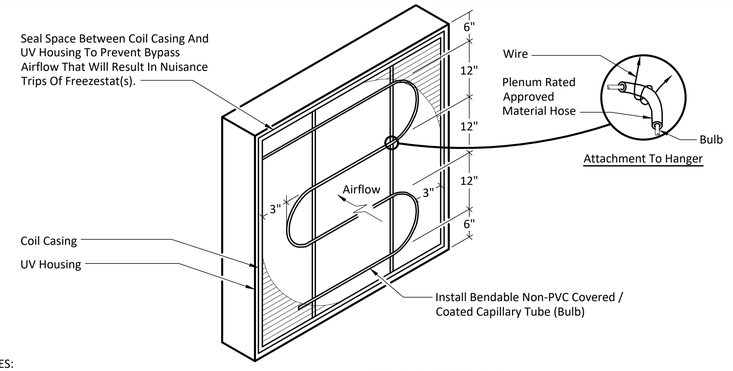


NOTES:
1. Mechanical Contractor Shall Be Responsible To Remove Existing Roofing Where New Equipment Curbs Are To Be Set And Where New Duct Penetrations Through The Roof Occur. Mechanical Contractor Shall Be Responsible To Cut New Roof Openings For New Ductwork, Piping, Etc. After Setting Of The Equipment Curbs, Provide New Roof Flashing And Counter Flashing. The Mechanical Contractor Shall Hire The Services Of The Roofing Contractor Responsible For The Existing Roof Warranty And Guarantees, To Install All Curbs So Not To Void Roof Warranty And Guarantees. Coordinate The Above With The Owner .

ROOF MOUNTED EXHAUST FAN | Scale: NTS | Drawing: **M202** Detail: **07**



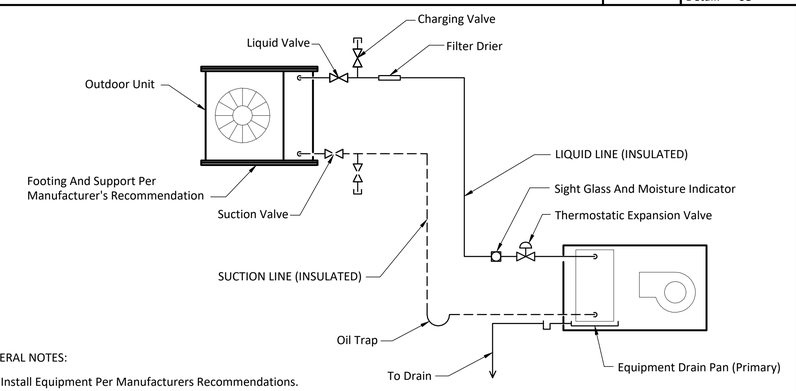
ROOFTOP AIR HANDLER INSTALLATION | Scale: NTS | Drawing: **M202** Detail: **02**



NOTES:
1. Install Freezestat Capillary Tube(s) On Upstream Face Of Each Coil. Provide Complete Coverage Such That Capillary Tube(s) Are Within 6" Of Every Point On Coil Face.
2. Provide Multiple Freezestats As Required For Complete Coverage.
3. Pitch Capillary Tube(s) Continually Downward Without Sagging. Refer To Manufacturer Documentation For Specific Requirements.

SEQUENCE OF OPERATIONS:
1. Upon Activation Of The Freezestat, The Following Shall Occur:
   - A. Air Handler (AHU) Fan Blower Motor Shall Stop
   - B. Associated DX Compressor Shall Lock Out
   - C. Outside Air Damper Shall Close Fully
   - D. Return Air Damper Shall Open Fully
   - E. Hot Water Control Valve Shall Open Fully
   - F. AHU Shall Display Alarm

FREEZESTAT COIL INSTALLATION DETAIL | Scale: NTS | Drawing: **M202** Detail: **05**



GENERAL NOTES:
1. Install Equipment Per Manufacturers Recommendations.
2. Provide Necessary Valves And Fittings To Accomodate These Requirements.
3. Slope Refrigerant Piping As Required By The Manufacturers Recommendations.
4. Coordinate Quantity, Size, And Routing Of Refrigerant Piping With Manufacturer.

SPLIT SYSTEM REFRIGERANT PIPING SCHEMATIC | Scale: NTS | Drawing: **M202** Detail: **08**

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project: NJDWSC WANAQUE SOUTH HVAC & LIGHTING REPLACEMENT 310 FAIRFIELD ROAD WAYNE, NJ 07470

title: DETAILS - 2

scale	drawn by	checked by	date	filename
AS SHOWN	CAD	DR	06/09/2023	12636M202

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ROOFTOP AIR HANDLER SCHEDULE - PUMP ROOM

UNIT ID	MODEL	AREA SERVED	SUPPLY FAN					HEATING COIL						FILTERS			ELECTRICAL			SOUND	WEIGHT	NOTES
			SUPPLY AIR (CFM)	OUTSIDE AIR (CFM)	ESP (IN WG)	TSP (IN WG)	MOTOR (HP)	CAPACITY (MBH)	EAT (DB °F)	LAT (DB °F)	APD (IN WG)	HW FLOW (GPM)	WPD (FT WG)	TYPE	QTY / SIZE (IN)	APD (IN WG)	VOLTAGE (V)	MCA (A)	MOCP (A)	(dBA)	(LB)	
AHU-1	CSAA035	Pump Room	20,400	2,040	1	2.8	(4) at 6HP	500.0	63	85.6	0.2	50.0	0.1	MERV 8	(16) 20x25	0.62	460	26.1	30	90	4,000	ALL
AHU-2	CSAA035	Pump Room	20,400	2,040	1	2.8	(4) at 6HP	500.0	63	85.6	0.2	50.0	0.1	MERV 8	(16) 20x25	0.62	460	26.1	30	90	4,000	ALL

NOTES:
1. Selection Is Based On Package Rooftop Air Handling Unit With Hot Water Heating By Trane.
2. Unit Controls With Graphic Touchscreen To Be Provided By Equipment Manufacturer. Include Labor To Field Modify Controls.
3. Provide Variable Frequency Drive On Supply Fans.
4. Static Pressure Indicated Above Is The External Static Pressure Which Excludes Any P.D. Within The Unit.
5. Units Shall Be Of Double Wall Construction. Units Shall Be Complete With Side Outlet Drain, Access Doors And Lights, And Economizer With Power Exhaust.
6. Maximum Air Velocity Thru Heating Coil Shall Not Exceed 500 Feet Per Min.
7. Provide 4 Sided Factory Equipment Rail Suitable For Seismic Conditions And Installation On Existing Steel Dunnage.
8. Electrical Connection To Be Single Point And To Be Through The Bottom Of The Unit. Provide Fused Disconnect Switch And 115 Volt GFI Convenience Receptacle.
9. Unit Shall Have Hinged Access Doors.
10. Coil Shall Be Coated With A Phenolic Coating.
11. Units Shall Have Full UL Listing.
12. Motor Efficiency Shall Match Premium Efficiency Table.
13. Provide Duct Smoke Detectors In Supply And Return.
14. Provide Phase And Brownout Protection.

HOT WATER UNIT HEATER SCHEDULE

UNIT ID	MODEL NO.	TYPE	LOCATION	CAPACITY (MBH)	EWT (°F)	LWT (°F)	WATER FLOW (GPM)	AIR FLOW (CFM)	EAT DB (°F)	LAT DB (°F)	MOTOR POWER (HP)	MOTOR VOLTAGE (V)	MOTOR PHASE (Ø)	MOTOR FREQ (HZ)	WEIGHT (LBS)	ACCESSORIES	NOTES
UH-1	VS-367	VERTICAL	CHLORINE ROOM	240	180	160	20.8	3,520	60	96	3/4	480	3	60	150	ALL	ALL
UH-2	VS-237	VERTICAL	CHLORINE ROOM	149	180	160	15.4	4,160	60	94	1/4	115	1	60	135	ALL	ALL
UH-3	VS-367	VERTICAL	CHLORINE ROOM	240	180	160	20.8	3,520	60	96	3/4	480	3	60	150	ALL	ALL
UH-4	HS-18	HORIZONTAL	FILE ROOM	27	180	160	2.7	630	60	99	1/20	115	1	60	50	ALL	ALL
UH-5	HS-360	HORIZONTAL	GENERATOR ROOM	12	180	160	1	400	60	85	16W	115	1	60	25	ALL	ALL
UH-6	HS-48	HORIZONTAL	SHOP	27	180	160	2.7	630	60	99	1/20	115	1	60	50	ALL	ALL
UH-7	HS-204	HORIZONTAL	SCREEN ROOM	124	180	160	12.7	2,900	60	100	1/3	115	1	60	100	ALL	ALL
UH-8	HS-204	HORIZONTAL	SCREEN ROOM	124	180	160	12.7	2,900	60	100	1/3	115	1	60	100	ALL	ALL
UH-9	HS-204	HORIZONTAL	SCREEN ROOM	124	180	160	12.7	2,900	60	100	1/3	115	1	60	100	ALL	ALL

NOTES:
1. Selection Based On Equipment Manufactured By Sterling.
2. Coils Shall Be Constructed Of 0.008" Thick Aluminum Fins Mechanically Bonded To 5/8" OD Expanded Copper Tubes.
3. Cabinets Shall Be Constructed Of Minimum 18 Gauge Steel. Finish And Color Shall Be As Selected By Owner.
4. Motors Shall Be Permanent Split Capacitor Type. Provide Fused Disconnect.
5. Units Shall Have Built-In Thermal Overload Protection.

ACCESSORIES:
1. Remote Thermostat
2. Ceiling Mounting Bracket

AIR HANDLING UNIT SCHEDULE - OFFICES

UNIT ID	MODEL NO.	AREA SERVED	SUPPLY FAN				HOT WATER HEAT SECTION							DX COOLING COIL				ELECTRICAL			WEIGHT	NOTES
			SUPPLY AIR (CFM)	OUTSIDE AIR (CFM)	ESP (IN WG)	MOTOR (HP)	CAPACITY (MBH)	FLOW (GPM)	EWT (°F)	LWT (°F)	APD (IN. WG)	WPD (FT. H2O)	ROWS	TOTAL (MBH)	SENS (MBH)	EAT (DB / WB °F)	LAT (DB / WB °F)	VOLTAGE (V)	MCA (A)	MOCP (A)	(LB)	
AHU-3	UCCAD10	Offices	4,000	400	1.0	5.0	108.0	10.8	180.0	160.0	0.1	0.4	1.0	125.0	97.8	80 / 67	57.4 / 57.2	460V / 3ϕ	7.0	15.0	1,100	ALL

NOTES:
1. Selection Is Based On Package Indoor Air Handling Unit With Hot Water Heating And DX Cooling By Trane.
2. Supply Fan Shall Be Variable Volume. Motor Shall Be Premium Efficiency Type. Controls Shall Adjust Fan Speed Based On Static Pressure In Ductwork Main.
3. Static Pressure Indicated Above Is The External Static Pressure Which Excludes Any P.D. Within The Unit.
4. Unit Shall Be Supported On 4" Tall Base Rail.
5. Unit Controls With Graphic Touchscreen To Be Provided By Equipment Manufacturer. Include Labor To Field Modify Controls.
6. Provide Unit With 2" Pleated MERV 13 Filters.
7. Provide 100% Comparative Enthalpy Low Leakage Economizer With Barometric Relief And Comparative Enthalpy Sensors.
8. Provide Duct Smoke Detector In Return.

EXHAUST FAN SCHEDULE

UNIT ID	MODEL NO.	TYPE	LOCATION	SERVICE	AIRFLOW (CFM)	S.P. (IN WG)	SPEED (RPM)	MOTOR HORSEPOWER (HP)	MOTOR VOLTAGE / PHASE (V)	MOTOR DRIVE	INTERLOCK	WEIGHT (LB)	NOTES	ACCESSORIES
EF-4, 5	G-100-VG	Centrifugal	Roof	VFD Room Exhaust	9,000	0.25	750	5	480 / 3ϕ	Direct	Thermostat	175	ALL	ALL
EF-6,7,8	SQ-100-VG	Centrifugal	Roof	Pump Room Exhaust	6,600	0.125	750	2	480 / 3ϕ	Direct	Thermostat	150	ALL	ALL
EF-9	SQ-100-VG	Centrifugal	Roof	PV Electric Area Exhaust	3,000	0.25	1,000	1	120 / 1ϕ	Direct	Thermostat	75	ALL	ALL
EF-10	SQ-100-VG	Centrifugal	Roof	Screen Room Exhaust	9,500	0.25	1,000	5	480 / 3ϕ	Direct	Thermostat	175	ALL	ALL
EF-11	SQ-100-VG	Centrifugal	Roof	Repair Shop Exhaust	250	0.25	1,300	1/60	120 / 1ϕ	Direct	Thermostat	20	ALL	ALL
EF-12	SQ-100-VG	Centrifugal	Roof	Toilet Exhaust	350	0.25	1,500	1/10	120 / 1ϕ	Direct	Light Switch	20	ALL	ALL
EF-13	SQ-60-VG	Centrifugal	Roof	Boiler Room Exhaust	900	0.25	1,500	1/6	120 / 1ϕ	Direct	Thermostat	40	ALL	ALL

NOTES:
1. Selection Based On Equipment Manufactured By Greenheck.
2. Motors Shall Be Of Premium Efficiency.
3. Fans Shall Be Fully Modulating EC Type With 0-10 VDC Input.

ACCESSORIES:
1. Fused Disconnect Switch
2. Integral Speed Controller
3. Motorized Damper
4. Remote Thermostat
5. 12" Roof Curb Adaptor With Damper Tray. Provide Unit With 24V Motorized Damper Interlocked With Fan Operation. Base Shall Be Hinged.

AIR SEPARATOR SCHEDULE

UNIT ID	MODEL NO.	SERVICE	TYPE	CAPACITY (GPM)	FITTING TYPE	WEIGHT (LBS)	NOTES
AS-1	R-4F	HOT WATER	TANGENTIAL	300	FLANGE	278	ALL

NOTES:
1. Selection Based On Rolairtrol Model Line Equipment Manufactured By Bell &Gossett.
2. Provide Unit With Integral Strainer.
3. Provide Unit With Optional Factory Welded Support Bracket.

DCA REVIEW

HOT WATER BOILER SCHEDULE

UNIT ID	MODEL NO.	RATING (BHP)	HEATING CAPACITY INPUT (MBH)	HEATING CAPACITY OUTPUT (MBH)	EWT (°F)	LWT (°F)	FLOW (GPM)	P.D. (IN W.G.)	FLUE DIAM (IN)	COMB. AIR DIAMETER (IN)	ELECTRICAL VOLTAGE (V)	ELECTRICAL PHASE (Ø)	ELECTRICAL MCA (A)	ELECTRICAL MOCP (A)	WEIGHT (LBS)	NOTES
B-1	PK Sonic SC-1500	42.2	1,500	1,456	180	160	145	8.3	10	12	208	1	10	20	1,500	ALL
B-2	PK Sonic SC-1500	42.2	1,500	1,456	180	160	145	8.3	10	12	208	1	10	20	1,500	ALL

NOTES:
1. Selection Based On Equipment Manufactured By Patterson Kelley, Which Shall Be Provided And Installed By Contractor.
2. Boilers Shall Fire Modules To Maintain The Constant Discharge Water Temperature Specified Above With Outdoor Air Reset Capability. Provide New Outdoor Air Temperature Sensor.
3. Provide Condensate Neutralizing Kit At Boiler.
4. Boiler Shall Be Sealed Combustion.
5. Provide Boiler Mounted Control Panel For Operation And Staging Of Boilers And Pumps.
6. Provide Natural Gas Regulator At Boiler. Regulator Shall Be Sized To Reduce Site Pressure (2PSI, Confirm In Field) To A Minimum Of 3.5" WC And Maximum 14" WC At Boiler.

AIR COOLED CONDENSING UNIT SCHEDULE - OFFICES

UNIT ID	MODEL NO.	ASSOCIATED AHU	AREA SERVED	SIZE (TONS)	ELECTRICAL VOLTAGE (V)	ELECTRICAL MCA (A)	ELECTRICAL MOCP (A)	IEER	WEIGHT (LB)	NOTES
CU-3	TTA12044CAA	AHU-3	Offices	10	460V / 3 ϕ	19	25.0	13	525	ALL

NOTES:
1. Selection Based On Equipment Manufactured By Trane.
2. Unit Performance Based On 95°F Ambient Air Temperature.
3. Unit Shall Have Two Scroll Compressors With Two Stage Capability (4 Total Stages).
4. Unit Shall Be Factory Assembled With Weatherproof Cabinets And Shall Be Complete With Fused Disconnect Switch.
5. Unit Shall Be UL Listed.
6. Refrigerant Shall Be R-410a.
7. Provide Support Rails Mounted To Grade.
8. Filter / Dryer Shipped Loose For Field Installation.

PUMP SCHEDULE

UNIT ID	MODEL NO.	SIZE	TYPE	SERVICE	FLOW (GPM)	TDH (FT. W.G.)	SPEED (RPM)	MOTOR POWER (HP)	MOTOR VOLTAGE (V)	MOTOR PHASE (Ø)	MOTOR FREQ (HZ)	WEIGHT (LBS)	NOTES
HWP-1,2	e-90	2AAC	INLINE	HOT WATER HEATING - ZONE 1 (AHU1-3, UH-5-9)	150	50	1,800	3	115	1	60	100	ALL
HWP-3,4	e-90	1.5AB	INLINE	HOT WATER HEATING - ZONE 2 (UH-1-4)	60	30	1,800	1	115	1	60	75	ALL
FZP-1,2	PL-100	2"	INLINE	HOT WATER CIRCULATOR - FREEZE PROTECTION	50	10	3,600	1/2	115	1	60	15	1-3
FZP-3	PL-36	1-1/4"	INLINE	HOT WATER CIRCULATOR - FREEZE PROTECTION	10.8	10	3,600	1/6	115	1	60	15	1-3

NOTES:
1. Selection Based On Equipment Manufactured By Bell&Gossett.
2. Pump Shall Be Furnished With A Premium Efficiency, Inverter Duty Motor.
3. Pumps Shall Be Bronze Fitted All Iron Construction.
4. Furnish And Install Variable Frequency Drives For Each Pump. Basis Of Design Is ABB Model ACH580.

ELECTRIC UNIT HEATER SCHEDULE

UNIT ID	MODEL NO.	TYPE	AIRFLOW (CFM)	ESP (IN WG)	CAPACITY (kW)	ELECTRICAL VOLTAGE (V)	ELECTRICAL MCA (A)	ELECTRICAL MOCP (A)	WEIGHT (LB)	ACCESSORIES	NOTES
EUH-1	HER30	Horizontal	380	0.25	3	480 / 3ϕ	4.8	15	30	1-3	1-5

NOTES:
1. Selection Based On Equipment Manufactured By Modine.
2. Cabinets Shall Be Constructed Of Minimum 14 Gauge Steel. Standard Factory Finish And Color.
3. Motors Shall Be Permanent Split Capacitor Type. Provide Fused Disconnect.
4. Configuration Shall Be Ceiling Mounted.
5. Units Shall Have Built-In Thermal Overload Protection.

ACCESSORIES:
1. Remote Thermostat
2. Factory Mounting Support Bracket.

EXPANSION TANK SCHEDULE

UNIT ID	MODEL NO.	SERVICE	TANK VOLUME (GAL)	ACCEPTANCE VOLUME (GAL)	TANK DIMENSIONS DIAMETER (IN)	TANK DIMENSIONS HEIGHT (IN)	WEIGHT (LBS)	NOTES
ET-1	B-500	HOT WATER SYSTEM	132.0	132	24	78	1450	ALL

NOTES:
1. Selection Based On Equipment Manufactured By Bell & Gossett.
2. Unit Shall Be Pre-Charged To 14 PSI.
3. Provide Seismic Restraints Option.
4. Expansion Tank Shall Be Bladder Type.

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REV.	DATE	ISSUE DESCRIPTION	ITEM	DATE	ISSUE DESCRIPTION
A	6/23/23	ISSUE FOR BID AND DCA REVIEW			

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project: NJDWSC WANAQUE SOUTH HVAC & LIGHTING REPLACEMENT 310 FAIRFIELD ROAD WAYNE, NJ 07470

title: SCHEDULES

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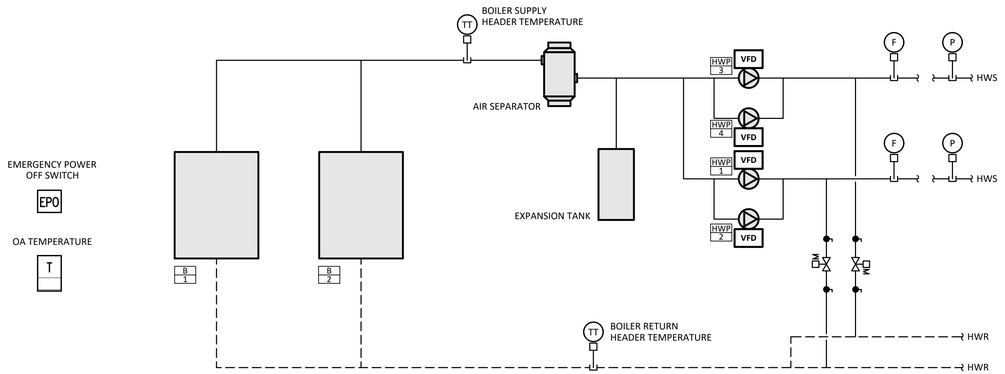
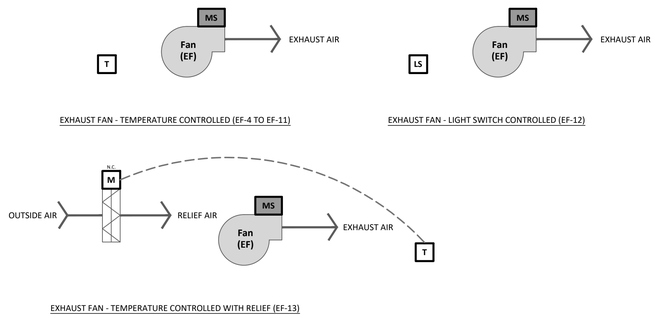


HEATING HOT WATER SYSTEM CONTROLS DIAGRAM

Scale: NTS

Drawing: **M500**
Detail: **01**



EXHAUST FAN CONTROLS DIAGRAM

Scale: NTS

Drawing: **M500**
Detail: **02**

DCA REVIEW

SEQUENCE OF OPERATION - BOILER

Hot Water Boilers

1. System Description
   A. Hot Water Boiler Plant

2. Equipment Referenced
   A. Hot Water Boilers (B)
   B. Pumps (P)

3. General:
   A. The Heating Hot Water Plant Consists Of Two (2) Gas Fired Hot Water Boilers, Four (4) Variable Volume Primary Heating Hot Water Pumps, Motorized Control Valves, Flow Meters, And Pressure / Temperature Instruments.
   B. The Heating Hot Water System Is Configured As A Variable Primary System.
   C. All Setpoints Shall Be Adjustable.
   D. A Boiler Mounted, Vendor Supplied Controller Shall Be Provided To Accomplish All Monitoring And Control As Outlined On The System Controls Drawing, Points List, And Sequence Of Operation.
   E. The Controller Shall Be Capable Of Connection To The Building Wide Controls Front End Through A BACnet MS/TP Network For Monitoring And Control At A Future Point.

4. Heating Loop Hot Water Pump Control:
   A. When The Heating Hot Water Plant Is Enabled (Outside Air Temperature Below 45 Deg F. Adjustable) The Primary Heating Loop Heating Hot Water Pumps Shall Be Commanded To Run.
   B. Pump Speed Shall Be Set Based On Maintaining Pressure Setpoint. Differential Pressure Sensors Shall Be Installed At A Point 2/3 Down The Piping Run. The Minimum Pump Speed Shall Be Set To Approximately 50 GPM.
   C. The Two-Way Modulating Valves In The Bypass Shall Modulate Open Based On The Total System Flow As Determined By The Hot Water Supply Flow Meter. Bypass Shall Be Used To Ensure Boiler Minimum Flow Is Always Met.
   D. The Heating Hot Water Plant Controller Shall Automatically Alternate The Primary And Secondary Assignment Of The Pumps To Equalize Run Time.
   E. If At Any Time The Status Of A Heating Loop Hot Water Pump Does Not Match The Command After A 30 Second Delay, The Pump Shall Be Disabled And An Alarm Shall Be Generated At The Unit Controller.

5. Boiler Plant Common Hot Water Supply Temperature Control:
   A. General:
      1) The Boiler Plant Shall Maintain The Heating Hot Water Common Supply Temperature At Setpoint (180F Adjustable).
      2) Boiler Will Be Enabled By The Unit Controller, After Run Proof Of Hot Water Pump / Flow And Shall Operate As Programmed To Maintain The Boiler Leaving Water Temperature At Setpoint.
   B. Boiler Sequencing:
      1) When The Plant Common Heating Hot Water Temperature Falls Below Setpoint, The Boiler Shall Be Enabled And The Boiler And Shall Operate Under Factory Installed Controls To Maintain Boiler Leaving Water Temperature At Setpoint. If Setpoint Is Not Met After 30 Minutes, Additional Boilers Shall Be Made Operational As Needed In Order To Meet Setpoint.
      2) When The Firing Rate Of The Boiler Reaches Minimum, The Boiler Shall Cycle To Maintain Its Leaving Water Temperature At Setpoint.
         a. Hot Water Supply Temperature Shall Be Based On An Outside Air Reset Schedule. The Outside Air Reset Schedule Programming Shall Be Integral To The Boiler Control Panel And Be Fully Adjustable. At An Outside Air Temperature Of 10°F, The Hot Water Supply Temperature Shall Be Maintained At 180°F. At An Outside Air Temperature Of 60°F, The Hot Water Supply Temperature Shall Be Maintained At 130°F. A Linear Relationship Shall Be Maintained Between These Two Points.
         b. When The Boiler Does Not Fire For A Minimum Of 30 Minutes, The Boiler Shall Be Disabled And The Pumps Run For An Additional Five Minutes And Then Turned Off.
   C. Alarms And Safeties:
      1) Boiler Failure: If At Any Time A Boiler Fails, Or Is Is Unable To Maintain Its Leaving Water Temperature At Setpoint For Five Minutes The Following Shall Occur.
         a. The Boiler Shall Be Disabled And An Alarm Shall Be Generated At The Unit Controller.
         b. The Lag Boiler Shall Be Enabled.
      2) Pump Failure: If At Any Time A Pump Fails, The Boiler Shall Be Disabled And An Alarm Shall Be Generated At The Unit Controller.
         a. The Lag Pump Shall Be Enabled.
      3) Emergency Shutdown: If The EPO Switches Are Activated, The Boilers And Pumps Shall Be Shutdown And The Gas Solenoid Valves Shall Close.
   D. Outside Air Reset:
      1) The Boiler Supply Water Setpoint Shall Be Determined By The Manufacturer Recommended Outside Air Reset Schedule. An Outside Air Temperature Sensor Shall Be Located At The Exterior Of The Boiler Room.

SEQUENCE OF OPERATION - EXHAUST FAN

Temperature Controlled Exhaust Fans (EF-4 To 13)

System Description

The Exhaust Fans Shall Operate When The Space Temperature Rises Above 80F (Adjustable) And Be Disabled When The Space Temperature Falls Below Setpoint Minus A Deadband Of 2F. The Fans Shall Have A Minimum Run Time Of Five Minutes Once Started.

Exhaust Fan EF-12 Shall Operate When The Light Switch In Either The Men's Or Women's Room Is Turned On.

Exhaust Fan EF-13 Shall Open A Motorized Damper In The Outside Air Louver Upon Activation For Pressure Relief. All Other Exhaust Fans Shall Utilize Existing Relief Systems.

GENERAL NOTES

1. All settings and setpoints are adjustable and shall be displayed at the unit and can be adjusted by users with administrator permissions.
2. Alarm and control setpoints shown are for initial deployment but may require adjustment where required as a result of field conditions, commissioning and / or test and balance. Final settings to be determined in the field by owner and contractor and captured in asbuilts.

PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description
XX	Field Device or Sensor (See Designation)
XXX / X	Equipment Identification
DP	Differential Pressure Sensor
F	Flow Meter
FA	Fire alarm system relay
FZ	Freezestat (Low Temperature Switch)
HP	High Pressure Switch
LS	Light Switch
M	Motorized Actuator (Damper Or Control Valve)
MS	Motor Starter
P	Pressure Sensor
PS	Differential Pressure Switch
SP	Static Pressure Sensor
T	Temperature Sensor
VFD	Variable Frequency Drive

N

KEY PLAN

ROOF
1ST

VERTICAL PLAN

REV.	DATE	ISSUE DESCRIPTION	ITEM	DATE	ISSUE DESCRIPTION
A	6/23/23	ISSUE FOR BID AND DCA REVIEW			

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NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
CONTROLS DETAILS - 1

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SEQUENCE OF OPERATION - AHU-1, 2

AHU-1, 2

System Description

The rooftop air handlers serve the pump room area. The AHUs are variable air volume single zone air handling units which provide general heating and ventilation. The AHUs supply heated air only to the space. The AHUs have economizer air dampers, modulating hot water heating section, and variable speed supply fan.

Supervisory Control

Supervisory control is handled by the unit controller and includes optimal start, equipment, and setpoint commands, monitoring, and alarming.

Occupancy Schedule

Unit controller provides adjustable occupied schedule and signals the unit to start in occupied mode.

Optimal Start - Morning Warmup

The AHUs shall start and run if required to raise the space temperature up to the occupied heating setpoints at the occupied start time. This algorithm is based on outside air temperature, space temperature, previous start time, and other adjustable factors. During this mode the unit runs as in the occupied mode except the outside air damper remains closed, relief air fan is off, and supply air temperature setpoint is 80°F. Unit enters occupied mode when the average space temperature is 68°F or occupancy start time is reached.

Occupied Heating

The economizer dampers are at minimum outside air and hot water heating control valve is modulated using a PID algorithm to maintain the supply air temperature at setpoint (64F adjustable).

Minimum Ventilation Airflow

The economizer dampers modulate using PID algorithm to maintain the outside airflow measured by the outside airflow station at the ventilation setpoint.

Airside Economizer

The economizer dampers shall be fixed at their minimum outside air position when conditions are not right for economization (outside air enthalpy greater than return air enthalpy). Economization is locked out when outside air dry bulb temperature exceeds 65°F

Supply Fan

Supply fan VFD speed is modulated using PID algorithm to maintain supply static duct pressure at setpoint.

Supply Duct Pressure Reset

ASHRAE Guideline 36P - Upon initial AHU startup supply duct static pressure setpoint shall be 0.5 in. w.c. After this initial startup delay, reset the setpoint from 0.5 in. w.c. to 1.5 in. w.c. using a "trim and respond" or "step and wait" approach.

Unoccupied / Standby Mode

Supply fan is off, the economizer dampers shall be closed to outside air (full return), and hot water coil valve closed.

Low Temperature Detector (Freeze Thermostat)

Low temperature detector averaging sensor on upstream face of heating coil shall disable the fan and open hot water valve via hardwire interlock when sensing temperatures below 40°F.

Smoke detector

Smoke detector shall be hardwired to the AHU supply fan start circuit. Upon activation, the smoke detector shall shut down the unit, and an alarm shall be generated that can be monitored by the equipment controller.

Mixed Air Low Temperature Limit

An averaging temperature sensor in the mixed air section will override economizer air damper control and close the outside air damper to maintain mixed air temperature above 50°F. Mixed air low limit control has priority over economizer cooling and CO2 control.

Supply Duct High Pressure Switch

A high supply duct static pressure switch in the AHU supply duct shall disable the fan via hardwire interlocked if the duct static pressure exceeds 3.0 in w.c. (field verify setpoint).

Air Filter Monitoring

A differential pressure sensor across the filter back is used to indicate filter change requirements. If the differential pressure exceeds 1.0 in. W.C. a dirty filter alarm is generated.

Communication Failure

Upon loss of communication of equipment controller with the unit, the unit shall default to occupied mode and maintain minimum outside air ventilation setpoint. All other control sequences remain the same. An alarm is generated at the equipment controller.

Controller or Power Failure

Upon failure of 120V power circuit or control transformer, the supply fan will stop, economizer dampers will fail to full recirculation, and heating will be disabled.

Freeze Protection Pump

The freeze protection pump shall run when the outside air temperature is below 45 degrees Fahrenheit or the low limit switch has been tripped.

SEQUENCE OF OPERATION - AHU-3

AHU-3

System Description

The air handler serves the office area. The AHU is a variable air volume single zone air handling unit which provide general cooling, heating, and ventilation to the space. The AHUs have economizer air dampers, DX cooling section, modulating hot water heating section, and variable speed supply fan.

Supervisory Control

Supervisory control is handled by the unit controller and includes optimal start, equipment, and setpoint commands, monitoring, and alarming.

Occupancy Schedule

Unit controller provides adjustable occupied schedule and signals the unit to start in occupied mode.

Optimal Start - Morning Warmup

The AHU shall start and run if required to raise the space temperature up to the occupied heating setpoint at the occupied start time. This algorithm is based on outside air temperature, space temperature, previous start time, and other adjustable factors. During this mode the unit runs as in the occupied mode except the outside air damper remains closed, relief air fan is off, and supply air temperature setpoint is 80°F. Unit enters occupied mode when the average space temperature is 68°F or occupancy start time is reached.

Optimal Start - Morning Cooldown (Pre-Cool)

The AHU shall start and run if required to decrease the space temperature to the occupied cooling setpoints at the occupied start time. This algorithm is based on outside air temperature, space temperature, previous start time, and other adjustable factors. During this mode the unit runs as in the occupied mode. Supply air temperature setpoint is fixed at 55°F and outside air damper is allowed to open for economizer cooling. Unit enters occupied mode when the average space temperature is 68°F or occupancy start time is reached.

Occupied Cooling

The economizer dampers and DX cooling coil shall modulate in sequence using a PID algorithm to maintain the supply air temperature at setpoint (74F adjustable). DX cooling is allowed to activate once economizer dampers are at 100% for 2 minutes.

Occupied Heating

The economizer dampers are at minimum outside air and hot water heating valve is modulated using a PID algorithm to maintain the supply air temperature at setpoint (70F adjustable). Simultaneous cooling and heating is not permitted.

Supply Air Temperature Reset

ASHRAE Guideline 36P - Upon initial AHU startup supply air temperature shall be 55°F. After this initial startup delay, reset the setpoint from 55°F to 65°F. using a "trim and respond" or "step and wait" approach. Every 2 minutes the BAS shall evaluate VAV terminal unit cooling demands and adjust the setpoint. If more than 2 VAV cooling demands are greater than 90% decrease the supply temperature setpoint by 0.2°F. If less than 1 zone has a cooling demand more than 90% increase the setpoint by 0.3°F in w.c. When in the dead band, maintain current setpoint.

Minimum Ventilation Airflow

The economizer dampers modulate using PID algorithm to maintain the outside airflow measured by the outside airflow station at the ventilation setpoint.

Airside Economizer

The economizer dampers shall be fixed at their minimum outside air position when conditions are not right for economization (outside air enthalpy greater than return air enthalpy). Economizer dampers open to outside air to provide free cooling as first "stage" of cooling prior to activating DX cooling based on differential enthalpy method. Economization is locked out when outside air dry bulb temperature exceeds 65°F

Supply Fan

Supply fan VFD speed is modulated using PID algorithm to maintain supply static duct pressure at setpoint.

Zone Dampers

Zone dampers shall modulate open based on temperature sensor input to maintain room temperature at setpoint (70F adjustable).

Supply Duct Pressure Reset

ASHRAE Guideline 36P - Upon initial AHU startup supply duct static pressure setpoint shall be 0.5 in. w.c. After this initial startup delay, reset the setpoint from 0.5 in. w.c. to 1.5 in. w.c. using a "trim and respond" or "step and wait" approach.

Unoccupied / Standby Mode

Supply fan is off, the economizer dampers shall be closed to outside air (full return), and hot water coil valve closed.

Low Temperature Detector (Freeze Thermostat)

Low temperature detector averaging sensor on upstream face of heating coil shall disable the fan and open hot water valve via hardwire interlock when sensing temperatures below 40°F.

Smoke detector

Smoke detector shall be hardwired to the AHU supply fan start circuit. Upon activation, the smoke detector shall shut down the unit, and an alarm shall be generated that can be monitored by the equipment controller.

Mixed Air Low Temperature Limit

An averaging temperature sensor in the mixed air section will override economizer air damper control and close the outside air damper to maintain mixed air temperature above 50°F. Mixed air low limit control has priority over economizer cooling and CO2 control.

Supply Duct High Pressure Switch

A high supply duct static pressure switch in the AHU supply duct shall disable the fan via hardwire interlocked if the duct static pressure exceeds 3.0 in w.c. (field verify setpoint).

Air Filter Monitoring

A differential pressure sensor across the filter back is used to indicate filter change requirements. If the differential pressure exceeds 1.0 in. W.C. a dirty filter alarm is generated.

Communication Failure

Upon loss of communication of equipment controller with the unit, the unit shall default to occupied mode and maintain minimum outside air ventilation setpoint. All other control sequences remain the same. An alarm is generated at the equipment controller.

Controller or Power Failure

Upon failure of 120V power circuit or control transformer, the supply fan will stop, economizer dampers will fail to full recirculation, and heating will be disabled.

Freeze Protection Pump

The freeze protection pump shall run when the outside air temperature is below 45 degrees Fahrenheit or the low limit switch has been tripped.

KEY NOTES (SYMBOLS ①, ②, ETC.)

1. Supply duct pressure sensor installed approximately 80% down supply air ductwork.
2. Provide multiple averaging freeze protection sensors if required for sufficient coil coverage.
3. Hardwire interlock to start fan circuit.

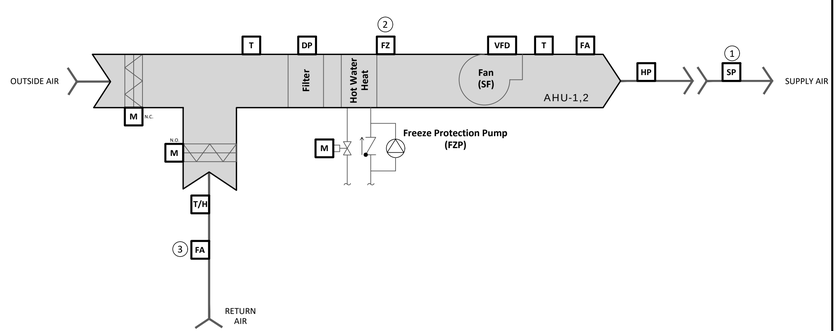
DCA REVIEW

GENERAL NOTES

1. All settings and setpoints are adjustable and shall be displayed at the unit and can be adjusted by users with administrator permissions.
2. Alarm and control setpoints shown are for initial deployment but may require adjustment where required as a result of field conditions, commissioning and / or test and balance. Final settings to be determined in the field by owner and contractor and captured in asbuilts.

PARTIAL SYMBOLS & ABBREVIATIONS

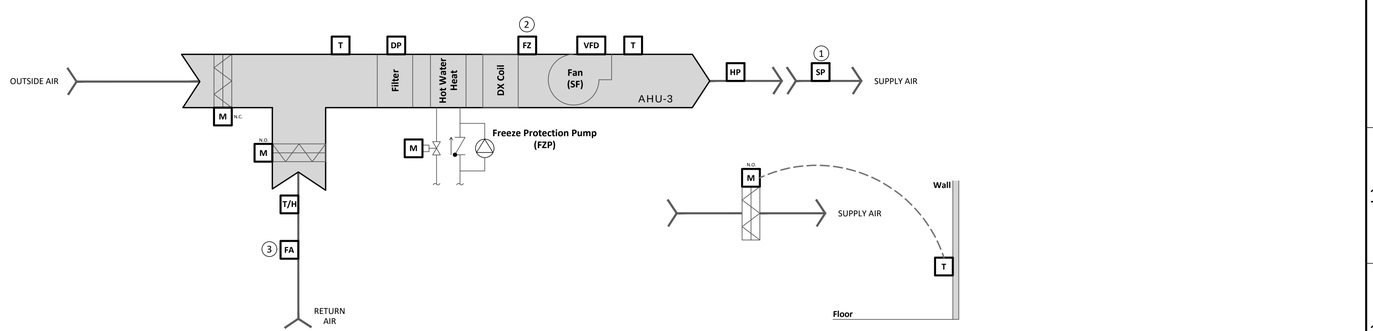
Identifier	Description
XX	Field Device or Sensor (See Designation)
XXX / X	Equipment Identification
DP	Differential Pressure Sensor
F	Flow
FA	Fire alarm system relay
FZ	Freezestat (Low Temperature Switch)
HP	High Pressure Switch
M	Motorized Actuator (Damper Or Control Valve)
PS	Differential Pressure Switch
SP	Static Pressure Sensor
T	Temperature Sensor
VFD	Variable Frequency Drive



SYSTEM DIAGRAM - AHU-1,2

Scale: NTS

Drawing: M501
Detail: 01



SYSTEM DIAGRAM - AHU-3

Scale: NTS

Drawing: M501
Detail: 02

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project
NJDWSC WANAQUE SOUTH
HVAC & LIGHTING REPLACEMENT
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WAYNE, NJ 07470

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CONTROLS DETAILS - 2

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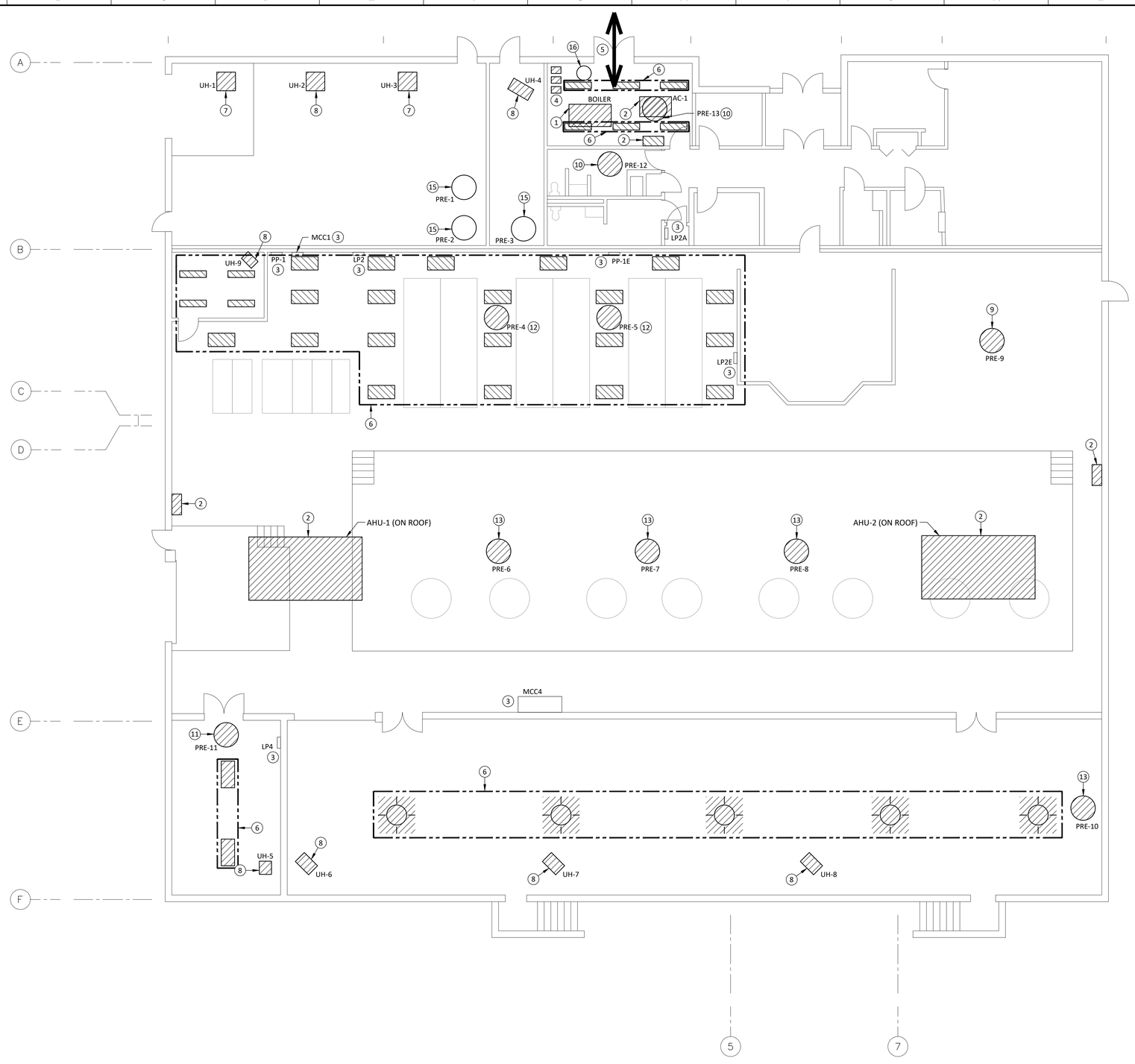

KEY NOTES (SYMBOLS 1, 2, ETC.)

1. Existing Boiler And All Electrical Connections To Be Removed. Power Is Fed From Panel PP-1E.
2. Existing Air Handler, Controls, And All Electrical Connections To Be Removed. Power Is Fed From Panel PP-1E.
3. Existing Panels To Remain.
4. Existing (3) Three Pumps And Controllers To Be Removed. Pumps Are Fed From Panel PP-1E.
5. Proposed Rigging Pathway Through Existing Double Door.
6. Existing Lighting Fixtures To Be Removed. Safe Off Wiring Until Ready For Installation Of New Lighting Fixtures. Power Is Fed From Panel LP-2A, LP-2E, And LP-4.
7. Existing Unit Heaters And All Electrical Connections To Be Removed. Power Is Fed From Panel PP-1E.
8. Existing Unit Heaters And All Electrical Connections To Be Removed. Power Is Fed From Panel LP-2E.
9. Existing Exhaust Fans And All Electrical Connections To Be Removed. Power Is Fed From Panel LP-2.
10. Existing Exhaust Fans And All Electrical Connections To Be Removed. Power Is Fed From Panel LP-2A.
11. Existing Exhaust Fans And All Electrical Connections To Be Removed. Power Is Fed From Panel LP-4.
12. Existing Exhaust Fans And All Electrical Connections To Be Removed. Power Is Fed From Panel MCC1.
13. Existing Exhaust Fans And All Electrical Connections To Be Removed. Power Is Fed From Panel MCC4.
14. Existing Air Handler, Controls, And All Electrical Connections To Be Removed. Power Is Fed From Panel PP-1.
15. Existing Equipment To Remain.
16. Existing Water Heater To Be Relocated. Wiring Shall Be Extended To New Location. Power Is Fed From Panel PP-1.

DCA REVIEW

GENERAL NOTES

1. Prior To Start Of Demolition Work, The Contractor Shall Coordinate Construction Schedule With NJDWSC Engineering Staff.
2. Trace Out And Label All Existing Conduit And Wiring In The Area Of Work And Affecting The Work Prior To Start Of Demolition.
3. Remove All Conduit, Wiring, Boxes And Devices Associated With Equipment To Be Demolished. Existing Conduit May Be Re-used.

PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description
	Equipment To Be Replaced
	High Bay Fixture To Be Replaced

KEY PLAN

VERTICAL PLAN

ROOF
1ST

FLOOR PLAN Scale: 1/8"=1'-0" (2' 4' 8' 16')

Drawing: **E101**
Detail: **01**

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project
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HVAC & LIGHTING REPLACEMENT
310 FAIRFIELD ROAD
WAYNE, NJ 07470

title
DEMOLITION PLAN

dwg. no.
E101

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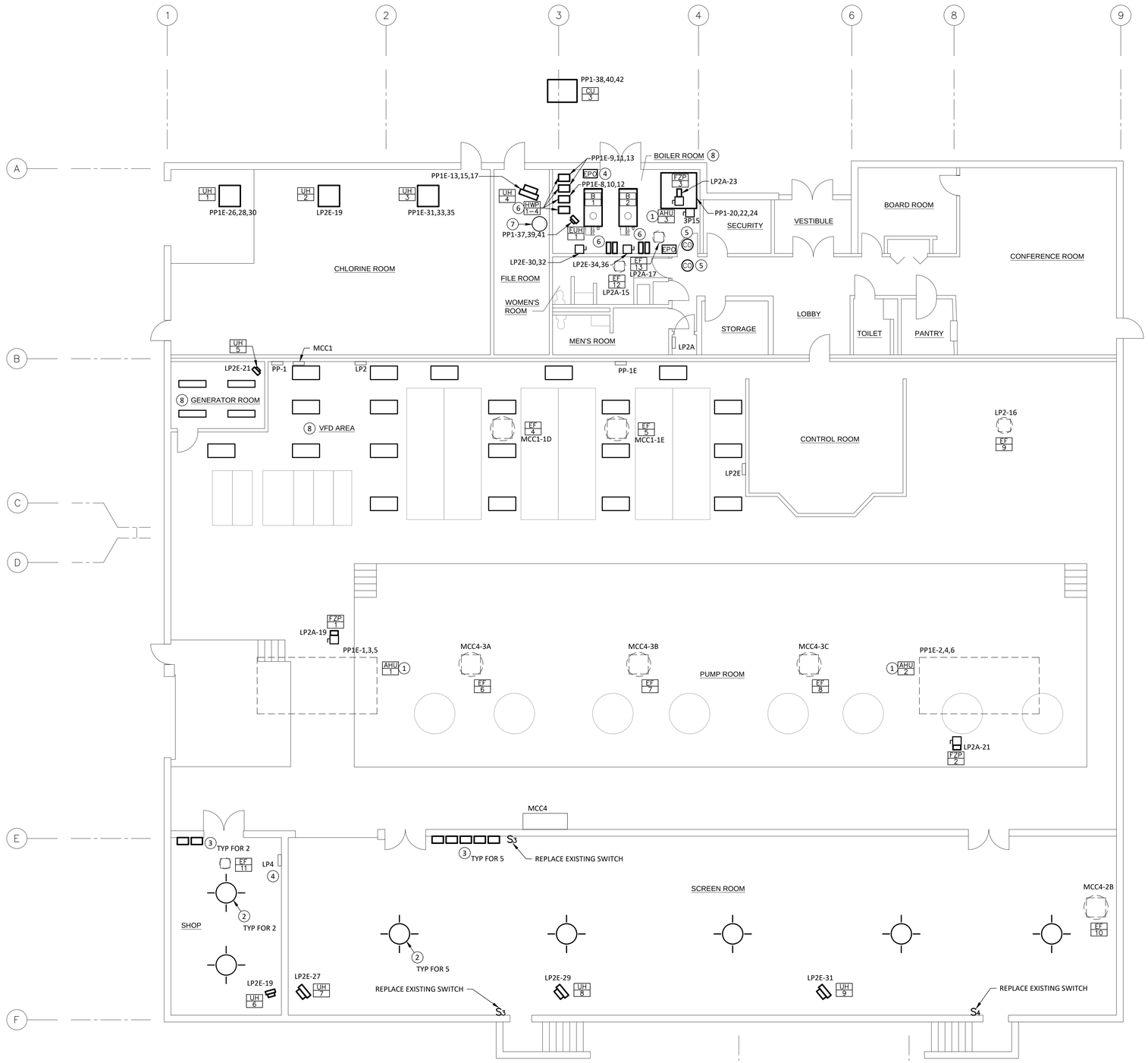


FLOOR PLAN Scale: 1/8"=1'-0" (2' 4' 8' 16') Drawing: **E102** Detail: **01**

KEY NOTES (SYMBOLS 1, 2, ETC.)

1. Wire New Duct Smoke Detectors Provided With Units To Existing Fire Alarm Circuit.
2. Bottom Of Fixture At 29'-2" AFF With 3'-10" From Fixture To Ceiling. Provide Aladdin ALL200 Light Lift, Fixture Lowering Device, Installed At Each High Bay Light Fixture Location.
3. Provide Aladdin Smart Lift Controller For Each Aladdin ALL200 Light Lift. Provide Aladdin 4/C, 22AWG Control Cable In 3/4" Conduit From Each Smart Lift Controller To Each Aladdin ALL200 Light Lift. Wire Unswitched Hot Wire To Lift Motor And Wire Switched Leg To Light Fixture. Utilize Existing 120V Lighting Circuits From Existing Lighting Panel LP-4.
4. Boiler Emergency Power Off (EPO) Switches Shall Disconnect Power To Both Boilers And Gas Solenoid Valves. Wire Each Boiler Via An Individual Enclosed EPO Contactor. Wire EPO Switches To EPO Contactor. Provide Outlet Box And Cover Painted Red With Sign Reading "Boilers #1 And #2 Emergency Off Switch". Feed From LP2E Circuit To Each EPO Contactor And From Each Contactor To Each Boiler Disconnect Switch. All Wiring Shall Be 2#12, #12G, 3/4" Conduit. Each Contactor Shall Be 2 Pole 20A Mechanically Held, 208V Coil.
5. Stand Alone CO Detector With Sounder Base.
6. Wire Each Hot Water Pump Pump Via Its Respective VFD. Coordinate VFD Locations In Field With Owner To Meet Required NEC 42" Front Working Clearance From Front Of VFD To Grounded Surface, 30" Wide.
7. Extend Wiring And Conduit To New Water Heater Location With 3#10, #10G, In 3/4" Conduit.
8. Install New Lighting Fixtures. Re-Use Existing 120V Lighting Circuits From Existing Panels, Extend Wiring As Required. 20 Lighting Fixtures In VFD Area, Six Lighting Fixtures In Boiler Room, And Four In Generator Room.

DCA REVIEW

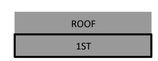
GENERAL NOTES

1. Relocate Existing Lighting As Required To Accommodate New Boilers And Existing Boiler Demolition.
2. For New Circuit Breakers Being Provided In Existing Panels, Contractor Shall Verify And Coordinate Exact Circuit Breaker Characteristics With Existing Distribution Panels. Match Existing Short Circuit Ratings. Provide Manufacturer Approved Kits And Hardware. Field Verify Existing Panels And Circuit Numbers That Are Being Used For New Work. Provide New, Typed Panel Directories.
3. Where Existing Conduits Are Re-Used, Extend Conduit As Required To New Equipment.
4. Circuit Numbers Shown Are Based On Existing 1984 Drawing Panel Schedules. Confirm Actual Circuit Numbers In Field.
5. Measure Existing Load On All Existing Panels / MCCs Being Used For New Work. Submit As-Built Panel Schedule Showing Each Existing Circuit And Listing Measured Current On Each Feeder / Branch And On Panel Mains. Coordinate With Owner To Energize All Existing Panel Loads Prior To Measurement.
6. Coordinate Electrical Equipment Locations In The Field To Meet Required NEC Working Clearance And Dedicated Space Requirements Per NEC 110.26. Do Not Locate Electrical Equipment Directly Below Piping, Ductwork, And Other Non-Electrical Items.
7. Refer To E103 For Lightning Protection Requirements For Rooftop Equipment.
8. Engage Existing Fire Alarm Service Company To Test Fire Alarm System After Connection Of New Devices.
9. Variable Frequency Drive Requirements (See Specification For Additional Details):
   a. Listed And Labeled As Defined In NFPA 70.
   b. Status Lights
   c. Panel-Mounted Operator Station Including Hand, Off, And Auto Modes.
   d. Operational Parameter Indication
   e. Control Signal Interfaces
   f. VFDs To Be Located By Contractor And Approved In Field By Owner Prior To Installation

PARTIAL SYMBOLS & ABBREVIATIONS

Identifier	Description	Identifier	Description
	New Rooftop Equipment		New Equipment
	High Bay LED Fixture	CO	Carbon Monoxide Detector
	Existing Equipment		Fused Disconnect Number Indicates Poles And Fuse Size

KEY PLAN



VERTICAL PLAN

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project
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NEW WORK PLAN

dwg. no.
E102

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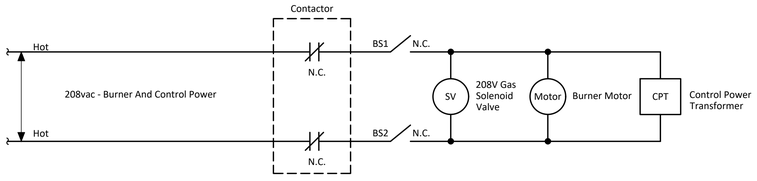
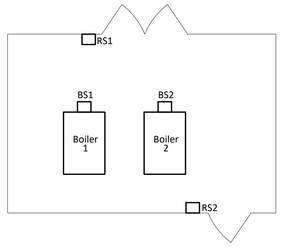
LIGHTING FIXTURE SCHEDULE

SYMBOL	TYPE	DESCRIPTION	TYPICAL LOCATION & APPLICATION	MOUNTING	VOLTAGE	LAMP TYPE	WATTAGE PER UNIT	MFG	CATALOG NUMBER (BASED ON LITHONIA)
	A	High Bay, 22" Diameter LED Lighting Fixture Marine Grade Forged Aluminum Housing	Screen Room	Ceiling	120	LED	224	Kenall Manufacturing	EPHB-22-UI-PM-CP-GW-224L-40K8-DCC-DV-R56
	B	LED Strip Light, 48" Long With Wire Guard	Boiler and Generator Rooms	Suspended	120	LED	35	Lithonia	CSS Contractor Single Strip LED
	C	LED 2x4, 48" Long	VFD Area	Suspended	120	LED	29	Lithonia	MSL-4000LM-L/LV-MVOLT

NOTES:
1. The Contractor Shall Provide Detailed Shop Drawings Of All Lighting Fixtures Including: Luminaire Data, Photometric Reports, Lamp Information, Emergency Lighting Equipment And Accessories Identified Above.
2. All Fluorescent Lighting Fixtures Shall Be Equipped With Energy Saving Low Mercury Lamps And Electronic Ballasts With A Total Harmonic Distortion <10%.
3. All Ballasts Shall Be Manufactured By Advance, Osram Sylvania, Universal, General Electric, Or Engineer Approved Equal.
4. Emergency Lighting Fixture's Specified With An Emergency Battery Pack Shall Provide 1,000 Lumens Minimum, Illuminate 2 Lamps For 90 Minutes, And Be Wired Ahead Local Switching.
5. All Ballasts Must Be Compatible And Coordinated With The Lighting Control System.
6. For Cable Hung Fixtures, Provide Additional Cabling For Emergency Battery Pack Power As Required.



Typical Wiring Diagram



Boiler Room Key Plan

NOTES:
1. BS1 And BS2 Are Lockable, Power Disconnect Switches Located At The Boiler (May Be Integral) That Will Disconnect All Power To The Boiler For Maintenance Purposes.
2. RS1 And RS2 Are Remote, Emergency Shutdown Switches Located By Exit Doors. Switches Shall Be DPST To Interface Up To Four Boilers And Two Remote Switches. Locate Switches Outside Of Room If Secure Location. If Not, Keep Switches Inside Of Room.
3. All Switches Shall Be Mushroom-Type Push Button And Rated For Circuit Ampacity And Boiler Motor HP. They Shall Have Red Cover Plates With Polycarbonate Piano-Hinge Covers To Prevent Accidental Activation. They Shall Be Marked With "Emergency Boiler Shutdown".

BOILER EMERGENCY SHUTDOWN WIRING DIAGRAM

Scale: NTS

Drawing: **E103**
Detail: **01**

PROJECT ELECTRICAL NOTES

Electrical Wiring

1. In General, Branch Circuit Wiring Is Not Shown On The Plan Drawings. Numerals Adjacent To Symbols For Receptacles, Motors, Appliances, Etc. Indicate The Panelboard And Circuit Number To Which The Item Is To Be Connected. Provide Branch Circuit Wiring For All Items Shown In Accordance With These General Notes And The Electrical Specifications.
2. Branch Circuit Wiring, Where Shown Is Intended To Show Specific Rounting Requirements.
3. Mechanical Equipment (Motors, HVAC Equipment, Etc.) Is Shown On Electrical Plan Drawings For Coordination And Are Only Approximate Locations. Refer To Mechanical Plans For Exact Locations.
4. All 1 Pole, 15 And 20 Amp Branch Circuits Serving Receptacles Or Lighting Shall Be 2 Wire Circuits Providing An Individual Neutral Conductor For Each Ungrounded (Hot) Circuit Conductor. Do Not Share Neutral Conductors.
5. The Minimum Branch Circuit Wiring Size Shall Be 2#12, #12 Ground In 3/4 Inch Conduit Unless Otherwise Noted.

Wiring Methods

1. General
   A. In Finished Areas, Conceal All Wiring In Building Walls, Floors, And Above Finished Ceilings. Wiring May Be Run Exposed In Mechanical/Electrical Equipment Rooms, Electrical Closets, Utility Rooms, And Unfinished Basements. No Wiring Shall Be Installed Exposed On The Outside Surfaces Of The Building(s).
   B. Final Connections To Mechanical Equipment, Lighting Fixtures, Motors, Transformers, Instruments, And Control Devices Shall Be Flexible Conduit To Minimize Vibration Transmission.
2. Indoors (Unclassified Areas)
   A. Exposed: RGS Threaded Conduit
   B. Final Connections: (Liquid-Tight Flexible Conduit Areas) Flexible Metal Conduit In Damp Or Wet

Equipment Grounding

1. An Insulated (Green) Equipment Ground Conductor(s) Shall Be Provided In All Feeders And Branch Circuits. Utilizing The Conduit As The Equipment Grounding Conductor Is Not Acceptable.

Electrical Enclosures And Terminations

1. Electrical Equipment Enclosures Shall Be Provided As Listed Below Unless Otherwise Noted.
   D. Indoors Unclassified Areas NEMA 1
   E. Indoors Classified 'Damp' NEMA 1
   F. Outdoors NEMA 3R
2. Electrical Terminations (Lugs, Terminals, Etc.) On All Equipment Shall Be Rated For Use With 75 Degree Celsius Conductors.

ELECTRICAL SYMBOL LIST

Identifier	Description
	Electrical Conduit
	Electrical Conduit Run Concealed Via Floors, Walls, Underground
	Conduit Homerun
	Conduit Turned Up
	Conduit Turned Down
	Conduit End (Capped)
	Existing Equipment And / Or Wiring
	Existing Equipment And / Or Wiring To Be Removed
	Junction Box

DCA REVIEW

LIGHTNING PROTECTION NOTES

1. Existing Building Lightning Protection System Shall Remain. Lighting Protection Shall Be Temporarily Removed During Demolition And Extended To New Equipment Installed On Roof.
2. System Shall Be Designed Per NFPA 780 And UL 96. Provide Master Label Certification Upon Completion Of Construction.
3. Lightning Protection System Is Delegated Design. Contractor Shall Engage A UL 96A And LPI Certified Lightning Protection Designer / Installer Specializing In Lightning Protection Design To Prepare Full Shop Drawing And Submittal Package.

ELECTRICAL ABBREVIATIONS

Identifier	Description	Identifier	Description
A	Amp	MDS	Main Distribution Switchboard
AC	Alternating Current	MLO	Main Lugs OnlyMOCP Maximum Overcurrent Protection
AF	Amp Frame		
AIC	Interrupting Capacity (RMS Symmetrical Amperes)	MV	Medium Voltage (> 600V)
		N	Neutral (Grounded Circuit Conductor)
AFI, AFCI	Arc Fault Current Interrupter	NC	Normally Closed
AT	Amp Trip	NEC	National Electrical Code
ATS	Automatic Transfer Switch	NEMA	National Elect. Manufacturer's Assoc.
C	Conduit	NO	Normally Open
CB	Circuit Breaker	NL	Night Light
CT	Current Transformer	PH, ϕ	Phase
DC	Direct Current	PF	Power Factor
EMT	Electrical Metallic Tubing	PRI	Primary
FACP	Fire Alarm Control Panel	PNL	Panel
G, GND	Ground	RECEPT	Receptacle
GFI, GFCI	Ground Fault Circuit Interrupter	RGS	Rigid Galvanized Steel
HV	High Voltage (> 69,000V)	SEC	Secondary
IG	Isolated Ground	STP	Shielded Twisted Pair
IMC	Intermediate Metal Conduit	SWBD	Switchboard
JB, J	Junction Box	TMCC	Temperature Motor Control Center
KCMIL	Thousand Circular Mil	UTP	Unshielded Twisted Pair
LRA	Locked Rotor Amps	V	Volt
LV	Low Voltage (< 50V)	VA	Volt-Ampere
MC	Metal Clad Cable	VAR	Volt-Ampere Reactive
MCB	Main Circuit Breaker	W	Watts
MCC	Motor Control Center	WP	Weatherproof
MDP	Main Distribution Panel	XFMR	Transformer

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title
LIGHTING SCHEDULE AND NOTES

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E103

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SCHEDULE FOR MOTOR CONTROL CENTER: Existing MCC-1

SYSTEM: **480Y/277V, 3Φ, 4W** **300A Vertical Bus, 1 Section** | EQUIP. GROUND BUS: **YES** | AREA SERVED: **WSPS**

MAIN BUS: | MCC SCCR: **100kA RMS SYM** | MCC CLASS: | MCC LOCATION: **WSPS**

MAINS TYPE: | MAINS RATING: **N / A** | MCC TYPE: | MOUNTING: **FLOOR** | SUPPLIED FROM:

ID #	SERVES	EQUIPMENT LOCATION	MOTOR HP	MOTOR PF	KVA	AMPS	MCP	CIR. BKR. P	CIR. BKR. TRIP	STARTER TYPE	STARTER SIZE	MINMUM FEEDER AND CONDUIT SIZE	CONTROL QTY.	CONTROL SIZE	OPTIONS	NOTES
1	Bucket 1A															2
2	Bucket 1C															2
3	Bucket 1D															2
4	Bucket 1D, EF-4, formerly PRE-4	Pump Switchgear Rm	5		6.3	8		3	15			3#12, #12G, 3/4"C				1, 3, 4
5	Bucket 1E, EF5, formerly PRE-5	Pump Switchgear Rm	5		6.3	8		3	15			3#12, #12G, 3/4"C				1, 3, 4
6	Bucket 1F															2
7																
8																
9																
10																
11																
12																

TOTAL CONNECTED LOAD (kVA) **13**

TOTAL CONNECTED LOAD (AMPS) **15**

NOTES:

1. Provide new wiring in existing conduit. Provide new breaker. 2. Existing loads to remain are not shown. Connected load indicated reflects only equipment being replaced.
2. Existing panel demand is not expected to change. Existing Exhaust Fans are being replaced in kind. 4. Reconfigure bucket, remove existing components, provide new thermal magnetic breaker.

SCHEDULE FOR MOTOR CONTROL CENTER: Existing MCC-4

SYSTEM: **480Y/277V, 3Φ, 4W** | EQUIP. GROUND BUS: **YES** | AREA SERVED: **WSPS**

MAIN BUS: **600 A** | MCC SCCR: **100kA RMS SYM** | MCC CLASS: | MCC LOCATION: **WSPS**

MAINS TYPE: **MLO** | MAINS RATING: **N / A** | MCC TYPE: | MOUNTING: **FLOOR** | SUPPLIED FROM:

ID #	SERVES	EQUIPMENT LOCATION	MOTOR HP	MOTOR PF	KVA	AMPS	MCP	CIR. BKR. P	CIR. BKR. TRIP	STARTER TYPE	STARTER SIZE	MINMUM FEEDER AND CONDUIT SIZE	CONTROL QTY.	CONTROL SIZE	OPTIONS	NOTES
1	Bucket 1A, 1B, 1C, 1D, 1E															2
2	Bucket 2A															2
3	Bucket 2B, EF-10, formerly PRE-10	Screen Room	5		6.3	8		3	15			3#12, #12G, 3/4"C				1, 3, 4
4	Bucket 2D															2
5	Bucket 2E															2
6	Bucket 3A, EF-6, formerly PRE-6	Pump Room	2		2.8	3		3	15			3#12, #12G, 3/4"C				1, 3, 4
7	Bucket 3B, EF-7, formerly PRE-7	Pump Room	2		2.8	3		3	15			3#12, #12G, 3/4"C				1, 3, 4
8	Bucket 3C, EF-8, formerly PRE-8	Pump Room	2		2.8	3		3	15			3#12, #12G, 3/4"C				1, 3, 4
9	Bucket 3D															2
10	Bucket 3E incoming line															
11																
12																

TOTAL CONNECTED LOAD (kVA) **15**

TOTAL CONNECTED LOAD (AMPS) **18**

NOTES:

1. Provide new wiring in existing conduit. Provide new breaker. 2. Existing loads to remain are not shown. Connected load indicated reflects only equipment being replaced.
2. Existing panel demand is not expected to change. Existing Exhaust Fans are being replaced in kind. 4. Reconfigure bucket, remove existing components, provide new thermal magnetic breaker.

SCHEDULE FOR PANEL: Existing LP4

SYSTEM: **208Y/120V, 3Φ, 4W** | NUMBER OF POLES: **42** | AREA SERVED: **WSPS**

BUS RATING: **100 A** | MINIMUM CB IC: **10kA RMS SYM** | EQUIP GROUND BUS: **YES** | PANEL LOCATION: **WSPS**

MAINS TYPE: **MLO** | MAINS RATING: **N / A** | ISOLATED GND BUS: **NO** | MOUNTING: **SURFACE** | SUPPLIED FROM:

CIR. #	SERVES	LOAD	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	BREAKER P	BREAKER TRIP	PHASE A	PHASE B	PHASE C	BREAKER TRIP	BREAKER P	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	LOAD	SERVES	CIR. #
1						0								2
3							0							4
5	See Note 2							0					See Note 2	6
7						0								8
9							0							10
11								0						12
13						0								14
15							0							16
17								0						18
19						0								20
21							1120		20	1	2#12, #12 G, 3/4" C	1120	Screen Room Lighting, note 1	22
23								0						24
25						0								26
27							0							28
29								0						30
31						0								32
33							0							34
35								0						36
37						0								38
39							0							40
41								0						42
						0	1120	0	VA PER PHASE					
						0	9	0	AMPS PER PHASE					

TOTAL CONNECTED LOAD (VA) **1120** **3** **TOTAL CONNECTED LOAD (AMPS)**

NOTES:

1. Provide new wiring in existing conduit. Re-use existing breaker. 2. Existing loads to remain are not shown. Connected load indicated reflects only equipment being replaced.
3. Existing panel demand is not expected to change. Existing lighting being replaced with new lighting.

SCHEDULE FOR PANEL: Existing LP2A

SYSTEM: **208Y/120V, 3Φ, 4W** | NUMBER OF POLES: **30** | AREA SERVED: **WSPS**

BUS RATING: **225 A** | MINIMUM CB IC: **10kA RMS SYM** | EQUIP GROUND BUS: **YES** | PANEL LOCATION: **WSPS**

MAINS TYPE: **MLO** | MAINS RATING: **N / A** | ISOLATED GND BUS: **NO** | MOUNTING: **SURFACE** | SUPPLIED FROM:

CIR. #	SERVES	LOAD	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	BREAKER P	BREAKER TRIP	PHASE A	PHASE B	PHASE C	BREAKER TRIP	BREAKER P	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	LOAD	SERVES	CIR. #
1						0								2
3							0							4
5	See Note 2							0					See Note 2	6
7						0								8
9							0							10
11								0						12
13						0								14
15	EF-12, formerly fed PRE-12, note 1	530	2#12, #12 G, 3/4" C	1	20		530							16
17	EF-13, Formerly fed PRE-13, note 1	530	2#12, #12 G, 3/4" C	1	20			530						18
19	FZP-1, note 4	1176	2#12, #12 G, 3/4" C	1	20	1176								20
21	FZP-2, note 4	1176	2#12, #12 G, 3/4" C	1	20		1176							22
23	FZP-3, note 4	1176	2#12, #12 G, 3/4" C	1	20			1176						24
25						0								26
27							0							28
29								0						30
						1176	1706	1706	VA PER PHASE					
						10	14	14	AMPS PER PHASE					

TOTAL CONNECTED LOAD (VA) **4588** **13** **TOTAL CONNECTED LOAD (AMPS)**

NOTES:

1. Provide new wiring in existing conduit. Re-use existing breaker. 2. Existing loads to remain are not shown. Connected load indicated reflects only equipment being replaced.
3. Existing panel demand of 23KW is increased by 3.5KW (3 HW pumps). Two existing exhaust fans are being replaced in kind. 4. Provide new breaker, new wiring and new conduit.

DCA REVIEW

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REV.	DATE	ISSUE DESCRIPTION	ITEM	DATE	ISSUE DESCRIPTION
A	6/23/23	ISSUE FOR BID AND DCA REVIEW			

24x36

dlbassociates consulting engineers
3600 Route 66, Suite 150 - #5981
Neptune NJ 07753
Questions For DLB Call: **Dan Rehberg**
DLB Project ID: 12636 Phone: 732-318-0314

project: NJDWSC WANAQUE SOUTH HVAC & LIGHTING REPLACEMENT 310 FAIRFIELD ROAD WAYNE, NJ 07470

title: PANEL SCHEDULES - 1

dwg. no.: E104

scale	drawn by	checked by	date	filename
AS SHOWN	DR	PE	06/09/2023	12636E104

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SCHEDULE FOR PANEL: Existing LP2E

SYSTEM:	**208Y/120V, 3Φ, 4W**			NUMBER OF POLES:	**42**			AREA SERVED:	**WSPS**								
BUS RATING:	**225 A**	MINIMUM CB IC:	**10kA RMS SYM**	EQUIP GROUND BUS:	**YES**			PANEL LOCATION:	**WSPS**								
MAINS TYPE:	**MLO**	MAINS RATING:	**N / A**	ISOLATED GND BUS:	**NO**			MOUNTING:	**SURFACE**			SUPPLIED FROM:					

CIR. #	SERVES	LOAD	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	BREAKER P	BREAKER TRIP	PHASE A	PHASE B	PHASE C	BREAKER TRIP	BREAKER P	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	LOAD	SERVES	CIR. #
1						0								2
3							0							4
5	See Note 2							0					See Note 2	6
7						0								8
9							0							10
11								0						12
13						0								14
15							0							16
17								0						18
19	UH-2 & 6, formerly UH-2,4,9 notes 1&5	940	2#12, #12 G, 3/4" C	1	20	940								20
21	UH-4&5, formerly UH5,6,7,8 notes 1&5	1200	2#12, #12 G, 3/4" C	1	20		1200							22
23								0						24
25						0								26
27	UH-7, notes 1 & 4	864	2#12, #12 G, 3/4" C	1	15		864							28
29	UH-8, notes 1 & 4	864	2#12, #12 G, 3/4" C	1	15			1696	20	2	2#12, #12 G, 3/4" C	832	Boiler B-1, Notes 4 & 6	30
31	UH-9, notes 1 & 4	864	2#12, #12 G, 3/4" C	1	15	1696						832	And 208V Gas Solenoid Valve	32
33							832		20	2	2#12, #12 G, 3/4" C	832	Boiler B-2, Notes 4 & 6	34
35								832				832	And 208V Gas Solenoid Valve	36
37						0								38
39							0							40
41								0						42
						2636	2896	2528	VA PER PHASE					
						22	24	21	AMPS PER PHASE					

TOTAL CONNECTED LOAD (VA) 8060 — **22** **TOTAL CONNECTED LOAD (AMPS)**

NOTES:
1. Provide new wiring in existing conduit. 2. Existing loads to remain are not shown. Connected load indicated reflects only equipment being replaced.
3. Existing panel demand is not expected to change. Existing unit heaters are being replaced in kind. 4. Provide New Breaker. 5. Re-use existing breaker. 6. Provide new conduit and wiring.

SCHEDULE FOR PANEL: Existing LP2

SYSTEM:	**208Y/120V, 3Φ, 4W**			NUMBER OF POLES:	**30**			AREA SERVED:	**WSPS**								
BUS RATING:	**225 A**	MINIMUM CB IC:	**10kA RMS SYM**	EQUIP GROUND BUS:	**YES**			PANEL LOCATION:	**WSPS**								
MAINS TYPE:	**MLO**	MAINS RATING:	**N / A**	ISOLATED GND BUS:	**NO**			MOUNTING:	**SURFACE**			SUPPLIED FROM:					

CIR. #	SERVES	LOAD	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	BREAKER P	BREAKER TRIP	PHASE A	PHASE B	PHASE C	BREAKER TRIP	BREAKER P	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	LOAD	SERVES	CIR. #
1						0								2
3							0							4
5	See Note 2							0					See Note 2	6
7						0								8
9							0							10
11								0						12
13						0								14
15							1920		30	1	2#10, #10 G, 3/4" C	1920	EF-9, Formerly PRE-9	16
17								0					Provide new breaker, see note 1	18
19						0								20
21							0							22
23								0						24
25						0								26
27							0							28
29								0						30
						0	1920	0	VA PER PHASE					
						0	16	0	AMPS PER PHASE					

TOTAL CONNECTED LOAD (VA) 1920 — **5** **TOTAL CONNECTED LOAD (AMPS)**

NOTES:
1. Provide new wiring in existing conduit. 2. Existing loads to remain are not shown. Connected load indicated reflects only equipment being replaced.
3. Existing panel demand is not expected to change. Existing exhaust fan is being replaced in kind.

SCHEDULE FOR PANEL: Existing PP1

SYSTEM:	**480Y/277V, 3Φ, 4W**			NUMBER OF POLES:	**42**			AREA SERVED:	**WSPS**								
BUS RATING:	**250 A**	MINIMUM CB IC:	**100kA RMS SYM**	EQUIP GROUND BUS:	**YES**			PANEL LOCATION:	**WSPS**								
MAINS TYPE:	**MCB**	MAINS RATING:	**200 A**	ISOLATED GND BUS:	**NO**			MOUNTING:	**SURFACE**			SUPPLIED FROM:					

CIR. #	SERVES	LOAD	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	BREAKER P	BREAKER TRIP	PHASE A	PHASE B	PHASE C	BREAKER TRIP	BREAKER P	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	LOAD	SERVES	CIR. #
1						0								2
3							0							4
5	See Note 2							0					See note 2	6
7						0								8
9							0							10
11								0						12
13						0								14
15							0							16
17								0						18
19						1551						1551	Formerly fed Office Air Conditioning	20
21							1551		15	3	3#12, #12 G, 3/4" C	1551	AHU-3, Office Air Conditioning, Note 1	22
23								1551				1551		24
25						0								26
27							0							28
29								0						30
31						0								32
33							0							34
35								0						36
37		1000				5432						4432		38
39	EUH-1, 3KW, Boiler Room, Note 1	1000	3#12, #12 G, 3/4" C	3	15		5432		25	3	3#10, #10 G, 3/4" C	4432	CU-3, Office Air Conditioning.	40
41		1000						5432				4432		42
						6983	6983	6983	VA PER PHASE					
						25	25	25	AMPS PER PHASE					

TOTAL CONNECTED LOAD (VA) 20949 — **25** **TOTAL CONNECTED LOAD (AMPS)**

NOTES:
1. Provide new wiring in existing conduit. Provide new breaker. 2. Existing loads to remain are not shown. Connected load indicated reflects only equipment being replaced.
2. Existing panel demand is not expected to change. Existing Office air conditioning is being replaced in kind. A 3KW unit heater is being added which is not concurrent with the AC load.

SCHEDULE FOR PANEL: Existing PP1E

SYSTEM:	**480Y/277V, 3Φ, 4W**			NUMBER OF POLES:	**42**			AREA SERVED:	**WSPS**								
BUS RATING:	**125 A**	MINIMUM CB IC:	**100kA RMS SYM**	EQUIP GROUND BUS:	**YES**			PANEL LOCATION:	**WSPS**								
MAINS TYPE:	**MCB**	MAINS RATING:	**100 A**	ISOLATED GND BUS:	**NO**			MOUNTING:	**SURFACE**			SUPPLIED FROM:					

CIR. #	SERVES	LOAD	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	BREAKER P	BREAKER TRIP	PHASE A	PHASE B	PHASE C	BREAKER TRIP	BREAKER P	MINIMUM BRANCH CIRCUIT & CONDUIT SIZE	LOAD	SERVES	CIR. #
1		5784				11568						5784		2
3	AHU-1, formerly AHU-1, Note 1	5784	3#10, #10 G, 3/4" C	3	30		11568		30	3	3#10, #10 G, 3/4" C	5784	AHU-2, formerly AHU-2, Note 1	4
5		5784						11568				5784		6
7		1662				1662								8
9	HWP-1 & 2, formerly Circ. Pump 1	1662	3#12, #12 G, 3/4" C	3	20		3767		20	3	3#12, #12 G, 3/4" C	2105	HWP-3, formerly Circulating Pump 3	10
11	2 @ 1 HP each, Note 1	1662						3767				2105	3 HP, Note 1	12
13		2105				4210						2105		14
15	HWP-4, formerly Circulating Pump 2	2105	3#12, #12 G, 3/4" C	3	20		2105						See Note 2	16
17	3 HP, Note 1	2105						2105						18
19						0								20
21	See Note 2						0							22
23								0						24
25						442						442		26
27							442		20	3	3#12, #12 G, 3/4" C	442	UH-1, formerly UH-1, Note 1, 3/4HP	28
29								442				442		30
31		442				442								32
33	UH-3, formerly UH-3, Note 1, 3/4HP	442	3#12, #12 G, 3/4" C	3	20		442							34
35		442						442						36
37						0								38
39							0							40
41								0						42
						18324	18324	18324	VA PER PHASE					
						66	66	66	AMPS PER PHASE					

TOTAL CONNECTED LOAD (VA) 54972 — **66** **TOTAL CONNECTED LOAD (AMPS)**

NOTES:
1. Provide new wiring in existing conduit. Re-use existing breaker. 2. Existing loads to remain are not shown. Connected load indicated reflects only equipment being replaced.
3. Existing panel demand is not expected to change. Two existing air handlers, 2 existing unit heaters, and 3 existing boiler pumps are being replaced in kind.

DCA REVIEW

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REV.	DATE	ISSUE DESCRIPTION	ITEM	DATE	ISSUE DESCRIPTION
A	6/23/23	ISSUE FOR BID AND DCA REVIEW			

dlbassociates consulting engineers
3600 Route 66, Suite 150 - #5981
Neptune NJ 07753
Questions For DLB Call: **Dan Rehberg**
DLB Project ID: 12636 Phone: 732-318-0314

project: NJDWSC WANAQUE SOUTH HVAC & LIGHTING REPLACEMENT 310 FAIRFIELD ROAD WAYNE, NJ 07470

title: PANEL SCHEDULES - 2

scale	drawn by	checked by	date	filename
AS SHOWN	DR	PE	06/09/2023	12636E105

dwg. no. E105

24x36

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ATTACHMENT #1

ACCESS APPROVAL

Pages (1) One

ACCESS APPROVAL FORM TO COMMISSION FACILITIES

COMPLETE ALL SECTIONS

PLEASE PRINT LEGIBLY

1. Name of Individual Entering Premises: _____
   a. Company Name: _____
   b. Date of Arrival: _____
   c. Time of Arrival: _____
   d. Your Contact Info: Phone: _____ Fax:_____ Email:_____

2. **Purpose:**
   a. Meeting: ( ) Interview: ( ) Pre-bid/Pre-Proposal Meeting: ( ) Bid Opening: ( )
   Bid/RFP # & Title: _____
   Meeting Scheduled With: _____
   Visiting which Commission Facility: _____
   b. Delivery: ( ) Routine -or- ( ) Special
   Purpose of Delivery: _____
   Contact Person at NJDWSC: _____
   Type: Package: _____ Chemical:_____ Other: _____
   Hazardous Materials ( ) **(Attach MSDS Sheets)**
   Other Materials Delivered or Transported to Commission Property (List Below):
   _____
   _____

3. Vehicle Make: _____ Year: _____ Color: _____ Lic. Plate #: _____
4. Emergency Contact Number of Your Firm: Name: _____
   Tele #: _____

Email completed Access Approval Form & Photo ID to security@njdwsc.com
***24 hours prior to arrival time*. For any questions, please call (973) 831-6200.**
A new Access Approval Form is required for each and every visit.

Approved by Commission: _____ Date:_____

Note: ***Prior to any and all contractors starting work on the property, they are to meet with a Safety Officer for site orientation and safety awareness training. This must be done for each employee and all sub-contractors.***

Revised: jv05-05

ATTACHMENT #2

VENDOR CERTIFICATION & DISCLOSURE OF POLITICAL CONTRIBUTIONS DISCLOSURE FORMS

Pages (7) Seven

ATTACHMENT #3

CONFIDENTIALITY & NON-DISCLOSURE AGREEMENT

Pages (5) Five

COMMISSIONERS

HOWARE L. BURRELL
CHAIRMAN
GLENWOOD, NJ

CHARLES P. SHOTMEYER
VICE CHAIRMAN
FRANKLIN LAKES, NJ

ALAN S. ASHKINAZE
ORADELL, NJ

DONALD C. KUSER
WAYNE, NJ

JAMES L. CASSELLA
EAST RUTHERFORD, NJ

CHRISTINA M. CUTRONE
FAIRLAWN, NJ

TERRANCE J. DUFFY
WEST MILFORD, NJ

ONE F.A. ORECHIO DRIVE
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TIMOTHY J. EUSTACE
EXECUTIVE DIRECTOR

WILLIAM SCHAFFNER
CHIEF FINANCIAL OFFICER

KIM DIAMOND
COMMISSION SECRETARY

CONFIDENTIALITY AND NONDISCLOSURE AGREEMENT

THIS CONFIDENTIALITY AND NONDISCLOSURE AGREEMENT (the "Agreement") is made and entered into as of this ____ day of _____, 2023 by and between:

THE NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION (hereinafter, the "Commission"), located at One F.A. Orechio Drive, Wanaque, New Jersey 07465; and

_____, and its affiliates and subsidiaries (hereinafter, "_____"), with a primary place of business located at _____ (and, together with the Commission, the "parties").

WITNESSETH

WHEREAS, pursuant to N.J.S.A. 58:5-1 et seq., the Commission is a public body corporate duly organized and existing under and by virtue of the laws of the State of New Jersey, exercising public and essential governmental functions and providing for the public health and welfare, and is engaged in developing raw water sources, storing water and distributing a reliable supply of potable water to its participating municipalities; and

WHEREAS, the Commission fulfills a vital role in maintaining, overseeing, and securing the operation of the largest regional water supply in the State of New Jersey, the safety and security of said operation constituting a critical Homeland Security concern; and

WHEREAS, in order to facilitate the possibility of entering into a contract for goods and services, and in particular, the procurement process pertaining to **CONTRACT #2112 WSPS HVAC REPLACEMENT PROJECT** Commission-Owned Facilities, and if entered into, the execution of such business relationship, the Commission may disclose certain non-public or proprietary information to_____ (or the "Receiving Party") and its representatives; and

WHEREAS, the Commission wishes to preserve the confidentiality and prevent the unauthorized disclosure and use of any such non-public or proprietary information disclosed to the Receiving Party and its representatives.

NOW THEREFORE, in consideration of the mutual promises, covenants, representations and warranties made in this Agreement, the receipt and sufficiency of which are hereby acknowledged by the parties, intending to be legally bound, hereby agree as follows:

1. "Information" means all non-public or proprietary information of the Commission disclosed in connection with this Agreement and shall include, but not be limited to, information regarding the Commission or its related entities' assets, liabilities, financial and other conditions, insurance, reinsurance, employees, consultants, operations, facilities, prospects, business plans, customer lists, or security arrangements. Information also includes any documents prepared by the Receiving Party that through the use of non-public proprietary Information that was provided to the Receiving Party by the Commission.

2. As a condition to receiving the Information which the Commission may furnish to the Receiving Party and its representatives or to which the Receiving Party and its representatives are afforded access, directly or indirectly, the Receiving Party and its representatives shall take all reasonable measures to avoid disclosure, dissemination or unauthorized use of Information, including, at a minimum, those measures that the Receiving Party takes to protect its own confidential information of a similar nature (provided that such measures are consistent with at least a reasonable degree of care).

3. Information does not include information that:

    a. Has been or becomes published or is now or in the future publicly available without breach of this Agreement or breach of a similar agreement by a third party or through no wrongful act of the receiving party or its representatives; or

    b. Is known to the Receiving Party prior to the time such information was acquired from the Commission under this Agreement as evidenced by the Receiving Party's contemporaneous written records; or

    c. Is independently developed and prepared by the Receiving Party not in reliance upon or reflecting any Information disclosed pursuant to this Agreement; or

    d. Subsequent to disclosure, is lawfully received from a third party having rights therein without restriction (to the best of the Receiving Party's knowledge) on the right of such third party or the Receiving Party to disseminate the information and without notice of any restriction against its further disclosure.

4. Information shall not, without the prior written consent of the Commission, be disclosed to any person or entity other than the Receiving Party's and its representatives' employees (including outside legal counsel, actuaries and accountants) who need to know the Information and in those instances only to the extent of such need. The Receiving Party agrees to keep all Information confidential, and further agrees to use Information solely for the evaluation stated above, and for no other purpose. The Receiving Party agrees that it and its representatives' employees (including outside legal counsel, actuaries and accountants) shall be informed of the terms of this Agreement.

5. All Information shall remain the exclusive property of the Commission, and the Receiving Party shall have no rights, by license or otherwise, to use Information except as expressly provided herein.

6. The Receiving Party agrees on its own behalf and on behalf of its representatives and/or assigns to return to the Commission or destroy, and verify in writing such destruction, all written, tangible or otherwise accessible material in any form (including electronic media such as computer diskettes, CD-ROM, electronic copies or any material resident in the hard or external drive of any computer) containing or reflecting any Information (including all copies, summaries, excerpts, extracts, notes or other reproductions) promptly at the request of the Commission or within sixty (60) days of the termination or conclusion of the parties' business or contractual relationship. All information retained by the Receiving Party pursuant to this Section 6 shall remain subject to the confidentiality and nondisclosure obligations of this Agreement. Notwithstanding anything to the contrary in this Agreement, the Receiving Party may retain one copy of Information that has become part of a file that the Receiving Party, in its reasonable judgment, is required to retain and/or make available for examination by government regulatory or investigatory agencies, or retain and/or produce by an order of a court or insurance regulatory agency.

7. Nothing in this Agreement shall impose any obligation upon either party to consummate a transaction, to enter into any discussion or negotiations with respect thereto, or to take any other action not expressly agreed to herein.

8. In the event that the Receiving Party receives a request to disclose all or any part of the Information as part of a governmental investigation or under the terms of a subpoena or order issued by a court or governmental body, the Receiving Party will take all reasonable steps to notify the Commission promptly in writing of such request in order to allow the Commission an opportunity to resist or narrow such request and will reasonably cooperate, at the Commission's expense, with the Commission and its representatives in connection with the Commission's efforts to resist or narrow such request. In the event that the Commission elects to waive the provisions of this Section 8 or is otherwise unsuccessful in resisting such request, the Receiving Party shall only disclose the Information that it determines it is legally required to disclose after consultation with competent counsel.

9. Except as required by applicable law or court or arbitral order, neither party shall in any way or in any form disclose (except as necessary to such party's outside legal counsel, actuaries and accountants), publicize or advertise in any manner the discussions or negotiations concerning the business purpose underlying this Agreement, or the status of any such discussions or negotiations without the consent of the other party.

10. This Agreement shall be deemed to be a contract made under the laws of the State of New Jersey and for all purposes shall be construed in accordance with the laws thereof. The parties agree that any and all disputes between the parties under or relating to the terms and conditions of this Agreement shall be fully and completely adjudicated in the courts of the State of New Jersey.

11. Any provision of this Agreement which may be prohibited or unenforceable in any jurisdiction shall, as to such jurisdiction, be ineffective to the extent of such prohibition or unenforceability without invalidating the remaining provisions hereof or affecting the validity or enforceability of such provision in any other jurisdiction.

12. Neither this Agreement nor any rights or obligations hereunder may be assigned by either party hereto without the prior written consent of the other party, and such consent shall not be unreasonably withheld, delayed or conditioned. This Agreement shall inure to the benefit of and be binding upon the parties hereto and their respective successors and assigns. No permitted assignment shall relieve a party of its obligations hereunder with respect to Information disclosed prior to the assignment. Any assignment in violation of this Paragraph Thirteen (12) shall be deemed null and void.

13. No amendment to any provision of this Agreement shall be binding and enforceable unless in writing and signed by both of the parties and specifically referencing this Agreement.

14. This Agreement shall continue to be binding after the conclusion of the business or contractual relationship between the parties absent prior written consent of both parties.

15. This Agreement shall not be interpreted in a manner that would violate any applicable cannons of ethics or codes of professional responsibility. Nothing in this Agreement shall prohibit or interfere with the ability of counsel for any party to represent any individual, corporation, or other entity adverse to any party or its affiliate(s) in connection with any other matters.

16. Each of the parties acknowledges and agrees that remedies at law may be inadequate to protect the Commission against any actual or threatened breach of this Agreement by the Receiving Party or its representatives, and, without prejudice to any other rights and remedies otherwise available to the Commission (including, without limitation, monetary damages), the Receiving Party agrees to the granting of specific performance and injunctive or other equitable relief in the Commission's favor without proof of actual damages and each of the parties further agrees to waive, and to use all reasonable efforts to cause its representatives to waive, any requirement for the securing or posting of any bond in connection with any such remedy. Nothing in this Agreement shall be deemed or construed to limit or prevent the Commission from bringing a claim for damages as a result of any actual or threatened breach of this Agreement by the Receiving Party or its representatives.

17. Each of the parties agrees that no failure or delay by the Commission in exercising any right or remedy hereunder will operate as a waiver thereof, nor will any single or partial exercise thereof preclude any other or further exercise of any right or remedy hereunder.

18. This Agreement was entered into solely to benefit the parties and no other person or entity shall have enforceable rights and remedies hereunder or hereby.

19. This Agreement may be executed in one or more counterparts (including via facsimile), each of which shall be deemed an original but all of which together shall constitute one in the same instrument.

20. This Agreement sets forth the entire understanding between the parties concerning the subject matters of the foregoing recitals and paragraphs.

IN WITNESS HEREOF, the parties have caused this Agreement to be executed by their authorized representatives on the date first written.

(CONTRACTOR)	**NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION**
By: _____	By: _____
Name: _____	Name: _____
Title: _____	Title: _____

ATTACHMENT #4

PROHIBITED RUSSIA-BELLARUS ACTIVITIES & IRAN INVESTMENT ACTIVITIES

Pages (3) Three

Prohibited Russia-Belarus Activities & Iran Investment Activities

Person or Entity	

Part 1: Certification

COMPLETE PART 1 BY CHECKING **ONE OF THE THREE BOXES BELOW**

Pursuant to law, any person or entity that is a successful bidder or proposer, or otherwise proposes to enter into or renew a contract, for goods or services must complete the certification below prior to contract award to attest, under penalty of perjury, that neither the person or entity, nor any parent entity, subsidiary, or affiliate, is identified on the Department of Treasury's Russia-Belarus list or Chapter 25 list as a person or entity engaging in prohibited activities in Russia, Belarus or Iran. Before a contract for goods or services can be amended or extended, a person or entity must certify that neither the person or entity, nor any parent entity, subsidiary, or affiliate, is identified on the Department of Treasury's Russia-Belarus list. Both lists are found on Treasury's website at the following web addresses:

https://www.nj.gov/treasury/administration/pdf/RussiaBelarusEntityList.pdf
www.state.nj.us/treasury/purchase/pdf/Chapter25List.pdf.

As applicable to the type of contract, the above-referenced lists must be reviewed prior to completing the below certification.

A person or entity unable to make the certification must provide a detailed, accurate, and precise description of the activities of the person or entity, or of a parent entity, subsidiary, or affiliate, engaging in prohibited activities in Russia or Belarus and/or investment activities in Iran. The person or entity must cease engaging in any prohibited activities and provide an updated certification before the contract can be entered into.

If a vendor or contractor is found to be in violation of law, action may be taken as appropriate and as may be provided by law, rule, or contract, including but not limited to imposing sanctions, seeking compliance, recovering damages, declaring the party in default, and seeking debarment or suspension of the party.

CONTRACT AWARDS AND RENEWALS

☐	*I certify, pursuant to law, that neither the person or entity listed above, nor any parent entity, subsidiary, or affiliate appears on the N.J. Department of Treasury's lists of entities engaged in prohibited activities in Russia or Belarus pursuant to P.L. 2022, c. 3 or in investment activities in Iran pursuant to P.L. 2012, c. 25 ("Chapter 25 List"). I further certify that I am the person listed above, or I am an officer or representative of the entity listed above and am authorized to make this certification on its behalf.* (Skip Part 2 and sign and complete the Certification below.)

CONTRACT AMENDMENTS AND EXTENSIONS	
☐	*I certify, pursuant to law, that neither the person or entity listed above, nor any parent entity, subsidiary, or affiliate is listed on the N.J. Department of the Treasury's lists of entities determined to be engaged in prohibited activities in Russia or Belarus pursuant to P.L. 2022, c. 3. I further certify that I am the person listed above, or I am an officer or representative of the entity listed above and am authorized to make this certification on its behalf.* (Skip Part 2 and sign and complete the Certification below.)
IF UNABLE TO CERTIFY	
☐	*I am unable to certify as above because the person or entity and/or a parent entity, subsidiary, or affiliate is listed on the Department's Russia-Belarus list and/or Chapter 25 Iran list. I will provide a detailed, accurate, and precise description of the activities as directed in Part 2 below, and sign and complete the Certification below. Failure to provide such will prevent the award of the contract to the person or entity, and appropriate penalties, fines, and/or sanctions will be assessed as provided by law.*

Part 2: Additional Information

PLEASE PROVIDE FURTHER INFORMATION RELATED TO PROHIBITED ACTIVITIES IN RUSSIA OR BELARUS AND/OR INVESTMENT ACTIVITIES IN IRAN.

You must provide a detailed, accurate, and precise description of the activities of the person or entity, or of a parent entity, subsidiary, or affiliate, engaging in prohibited activities in Russia or Belarus and/or investment activities in Iran in the space below and, if needed, on additional sheets provided by you.

Part 3: Certification of True and Complete Information

I, being duly sworn upon my oath, hereby represent and state that the foregoing information and any attachments there, to the best of my knowledge, are true and complete. I attest that I am authorized to execute this certification on behalf of the above-referenced person or entity.

I acknowledge that the ***North Jersey District Water Supply Commission*** *is relying on the information contained herein and hereby acknowledge that I am under a continuing obligation from the date of this certification through the completion of any contracts with the* ***North Jersey District Water Supply Commission*** *to notify the* ***North Jersey District Water Supply Commission*** *in writing of any changes to the answers of information contained herein.*

I acknowledge that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification. If I do so, I recognize that I am subject to criminal prosecution under the law and that it will also constitute a material breach of my agreement(s) with the ***North Jersey District Water Supply Commission*** *and that the* ***North Jersey District Water Supply Commission*** *at its option may declare any contract(s) resulting from this certification void and unenforceable.*

Full Name (Print)		**Title**	
Signature		**Date**	