SPECIFICATIONS

GULF COST REHABILITATION CENTER

PANAMA CITY, FL

ACHA CLIENT CODE/ FILE #:

35/2032-32589

OWNER
GCRC, INC.
1937 JENKS AVE.
PANAMA CITY, 32405

CIVIL ENGINEER
GORTEMOLLER ENGINEERING
708 THOMAS DRIVE
PANAMA CITY BEACH, FL 32408

MECHANICAL ENGINEER
INGENUITY ENGINEERS, INC.
6275 HAZEL TINE NATIONAL DRIVE
ORLANDO, FL 32822

ELECTRICAL ENGINEER
INGENUITY ENGINEERS, INC.
6275 HAZEL TINE NATIONAL DRIVE
ORLANDO, FL 32822

PLUMBING ENGINEER
INGENUITY ENGINEERS, INC.
6275 HAZEL TINE NATIONAL DRIVE
ORLANDO, FL 32822

ARCHITECT
FOSHEE ARCHITECTURE
21 S. COURT STREET
MONTGOMERY, AL 36104

STRUCTURAL ENGINEER
KE'ANO ENGINEERING
P.O. BOX 240092
ECLECTIC, AL 36024

INTERIOR DESIGNER
ELIZABETH WILSON DESIGNS, LLC
3412 N WOODRIDGE ROAD
MOUNTAIN BROOK, AL 35223

CONSTRUCTION DOCUMENTS

ACHA CLIENT CODE/ FILE NUMBER:
OPC PROJECT #35/20302-32589

ARCH PROJECT NO.: 22-45

DATE: MAY 31, 2024 (Revised 08-23-2024)

STATE OF FLORIDA
JOHN H. FOSHEE
AR101450
REGISTERED ARCHITECT

FOSHEE ARCHITECTURE
21 S. COURT STREET
MONTGOMERY, AL 36104
(334)273-8733

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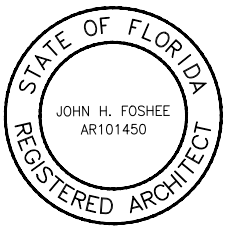

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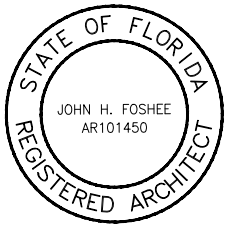

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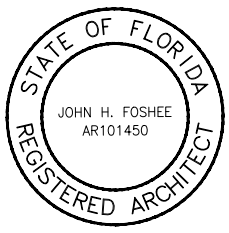

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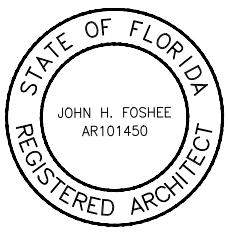

FORM OF PROPOSAL

To: **Mr. John Warren & Mr. Randal McElheney**
Gulf Coast Rehab Center, Inc.
P.O. Box 28330
Panama City, FL 32411

Date: _____

Sealed bids will be accepted by email, no later than 2:00pm on Thursday, November 14th, 2024. Bids are to be emailed to John Warren (jw27122@gmail.com), Randal McElheney (randallmcelheney@gmail.com) and Barrett Penney (barrett@fosheecompanies.com)

The Undersigned, as Bidder, hereby declares that the only person or persons interested in the Proposal as Principal or Principals is or are as herein named and that no other person than herein named has any interest in this Proposal or in the Contract to be entered into; that this Proposal is made without connection with any other person, company, or parties making a bid or proposal; and that it is in all respects fair and in good faith, without collusion or fraud.

The Bidder further declares that he has examined the site of the Work and informed himself fully in regard to all conditions pertaining to the place where the Work is to be done, and that he has examined the Drawings and Specifications for the Work and the other Contract Documents relative thereto, and that he has satisfied himself relative to the Work to be performed, including Addenda Numbers:

Addenda Numbers:

_____

In compliance with your **Bid,** dated _____

and subject to all the conditions thereof, the undersigned _____

_____ , Florida Registration No. _____

Classification _____ , a corporation organized and existing under the

laws of the State of _____

A Partnership consisting of _____

or an Individual trading as _____

of the City of _____

hereby proposes to furnish all labor and materials and perform all work required for the construction of _____

The Gulf Coast Rehabilitation Center, 1937 Jenks Ave., Panama City, Florida, 32405 .

_____

_____

in accordance with Drawings and Specifications, dated **31 May, 2024**

prepared by **Foshee Architecture, 21 S. Court Street, Montgomery, AL 36104**

BASE BID: For construction complete as shown and specified, the sum of _____

_____ Dollars ($_____).

INFORMATIONAL PRICING: Performance & Payment Bonds, represents a sum of _____.

. _____ Dollars ($. _____).

The Bidder further proposes and agrees to commence the Work with an adequate force and equipment within _____ consecutive calendar days from date of Notice to Proceed and complete the work within _____ calendar days.

WITNESSES:

_____ _____ (L.S.)

_____ by _____ (L.S.)

The full names and residences of persons and firms interested in the foregoing Bid as Principals are as follows:

_____ _____

DRAFT

AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

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

«The Gulf Coast Rehabilitation Center»
«Panama City, Florida»

THE OWNER:
(Name, legal status and address)

«John Warren & Randal McElheney»
«P.O. Box 28330»
«Panama City, FL 32411»

THE ARCHITECT:
(Name, legal status and address)

«Foshee Architecture»
«21 S. Court Street»
«Montgomery, AL 36104»

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ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

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

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

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14 TERMINATION OR SUSPENSION OF THE CONTRACT

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(Topics and numbers in bold are Section headings.)

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

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

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

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

§ 1.1.8 Initial Decision Maker

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

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

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

§ 1.6 Notice

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

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

§ 1.7 Digital Data Use and Transmission

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

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or

relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

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

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

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

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

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

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

§ 2.3 Information and Services Required of the Owner

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

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

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

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

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

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

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

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

ARTICLE 3 CONTRACTOR

§ 3.1 General

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

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as

the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

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

§ 3.4 Labor and Materials

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

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

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

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

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

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

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

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

§ 3.7.4 Concealed or Unknown Conditions

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

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

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

§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

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

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

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

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

§ 3.10 Contractor's Construction and Submittal Schedules

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

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

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

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and

similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

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

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

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

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

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

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

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

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

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

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will

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

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

§ 3.13 Use of Site

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

§ 3.14 Cutting and Patching

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

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

§ 3.15 Cleaning Up

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

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

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

§ 3.17 Royalties, Patents and Copyrights

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

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

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

ARTICLE 4 ARCHITECT

§ 4.1 General

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

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

§ 4.2 Administration of the Contract

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

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

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

§ 4.2.4 Communications

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

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

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

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

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

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

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

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

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

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

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

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in

number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

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

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

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

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

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

§ 5.3 Subcontractual Relations

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

§ 5.4 Contingent Assignment of Subcontracts

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

- **.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- **.2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

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

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

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

§ 6.2 Mutual Responsibility

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

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

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

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

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

§ 6.3 Owner's Right to Clean Up

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

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

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

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

§ 7.2 Change Orders

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

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

§ 7.3 Construction Change Directives

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

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

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

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

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- **.1** Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

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

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

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

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

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

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

§ 7.4 Minor Changes in the Work

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

ARTICLE 8 TIME

§ 8.1 Definitions

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

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

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

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

§ 8.2 Progress and Completion

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

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

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

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

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

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

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

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

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

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

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

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

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

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

§ 9.4 Certificates for Payment

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

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

§ 9.5 Decisions to Withhold Certification

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

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or

.7 repeated failure to carry out the Work in accordance with the Contract Documents.

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

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

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

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

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

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

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

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

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

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

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

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

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

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

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

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

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

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

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

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

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

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

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

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

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

§ 10.2 Safety of Persons and Property

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

- **.1** employees on the Work and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

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

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

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

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

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

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

§ 10.2.8 Injury or Damage to Person or Property

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

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed

by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

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

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

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

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the

procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

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

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

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

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

§11.5 Adjustment and Settlement of Insured Loss

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

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

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

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

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

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

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

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

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

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

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

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

§ 12.3 Acceptance of Nonconforming Work

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

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

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

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

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

§ 13.3 Rights and Remedies

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

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

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect

timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

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

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

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

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

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

§ 13.5 Interest

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

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

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

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- **.3** Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- **.4** The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

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

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract

Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- **.4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

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

- **.1** Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- **.2** Accept assignment of subcontracts pursuant to Section 5.4; and
- **.3** Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

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

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

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

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

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

§ 14.4 Termination by the Owner for Convenience

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

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

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

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work

properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

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

§ 15.1.5 Claims for Additional Cost

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

§ 15.1.6 Claims for Additional Time

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

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

§ 15.1.7 Waiver of Claims for Consequential Damages

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

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

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

§ 15.2 Initial Decision

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

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

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

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

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

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

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

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

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

§ 15.3 Mediation

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

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

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

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

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

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

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

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

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party

provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

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

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

DRAFT

AIA® Document G701™ – 2017

Change Order

PROJECT: *(Name and address)*
Washington County Hospital
Facade Renovations

CONTRACT INFORMATION:
Contract For:
Date:

CHANGE ORDER INFORMATION:
Change Order Number:
Date:

OWNER: *(Name and address)*
«John Warren & Randal McElheney
P.O. Box 28330»
«Panama City, FL 32411»

ARCHITECT: *(Name and address)*
«Foshee Architecture»
«21 S. Court Street»
«Montgomery, AL 36104»

CONTRACTOR: *(Name and address)*

THE CONTRACT IS CHANGED AS FOLLOWS:
(Insert a detailed description of the change and, if applicable, attach or reference specific exhibits. Also include agreed upon adjustments attributable to executed Construction Change Directives.)

The original Contract Sum was	$	0.00
The net change by previously authorized Change Orders	$	0.00
The Contract Sum prior to this Change Order was	$	0.00
The Contract Sum will be increased by this Change Order in the amount of	$	0.00
The new Contract Sum including this Change Order will be	$	0.00

The Contract Time will be increased by Zero (0) days.
The new date of Substantial Completion will be

NOTE: This Change Order does not include adjustments to the Contract Sum or Guaranteed Maximum Price, or the Contract Time, that have been authorized by Construction Change Directive until the cost and time have been agreed upon by both the Owner and Contractor, in which case a Change Order is executed to supersede the Construction Change Directive.

NOT VALID UNTIL SIGNED BY THE ARCHITECT, CONTRACTOR AND OWNER.

ARCHITECT *(Firm name)*	CONTRACTOR *(Firm name)*	OWNER *(Firm name)*
SIGNATURE	SIGNATURE	SIGNATURE
PRINTED NAME AND TITLE	PRINTED NAME AND TITLE	PRINTED NAME AND TITLE
DATE	DATE	DATE

DRAFT

AIA® Document G706™ – 1994

Contractor's Affidavit of Payment of Debts and Claims

PROJECT: *(Name and address)* The Gulf Coast Rehabilitation Center	**ARCHITECT'S PROJECT NUMBER:** 22-45 **CONTRACT FOR:** General Construction	OWNER: ☐ ARCHITECT: ☐ CONTRACTOR: ☐
TO OWNER: *(Name and address)* «John Warren & Randal McElheney P.O. Box 28330» «Panama City, FL 32411»	**CONTRACT DATED:**	SURETY: ☐ OTHER: ☐

STATE OF:
COUNTY OF:

The undersigned hereby certifies that, except as listed below, payment has been made in full and all obligations have otherwise been satisfied for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or Owner's property might in any way be held responsible or encumbered.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Consent of Surety to Final Payment. Whenever Surety is involved, Consent of Surety is required. AIA Document G707, Consent of Surety, may be used for this purpose

Indicate Attachment ☐ Yes ☒ No

The following supporting documents should be attached hereto if required by the Owner:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.

2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

3. Contractor's Affidavit of Release of Liens (AIA Document G706A).

CONTRACTOR: *(Name and address)*

BY: _____
(Signature of authorized representative)

_____
(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

DRAFT

AIA® Document G706A™ – 1994

Contractor's Affidavit of Release of Liens

PROJECT: *(Name and address)* The Gulf Coast Rehabilitation Center	**ARCHITECT'S PROJECT NUMBER:** 22-45 **CONTRACT FOR:** General Construction	OWNER: ☐ ARCHITECT: ☐ CONTRACTOR: ☐ SURETY: ☐ OTHER: ☐
TO OWNER: *(Name and address)* «John Warren & Randal McElheney P.O. Box 28330» «Panama City, FL 32411»	**CONTRACT DATED:**	

STATE OF:
COUNTY OF:

The undersigned hereby certifies that to the best of the undersigned's knowledge, information and belief, except as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services who have or may have liens or encumbrances or the right to assert liens or encumbrances against any property of the Owner arising in any manner out of the performance of the Contract referenced above.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

CONTRACTOR: *(Name and address)*

BY: _____
(Signature of authorized representative)

_____
(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

DRAFT

AIA® Document G707™ – 1994

Consent Of Surety to Final Payment

PROJECT: *(Name and address)*
The Gulf Coast Rehabilitation Center

ARCHITECT'S PROJECT NUMBER: 22-45

CONTRACT FOR:

CONTRACT DATED:

OWNER: ☐
ARCHITECT: ☐
CONTRACTOR: ☐
SURETY: ☐
OTHER: ☐

TO OWNER: *(Name and address)*

«WCH Nursing Home»
«14600 St. Stephens Ave.»
«Chatom, AL 36518»

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the
(*Insert name and address of Surety*)

, SURETY,

on bond of
(Insert name and address of Contractor)

, CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety of any of its obligations to
(Insert name and address of Owner)

, OWNER,

as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand on this date:
(Insert in writing the month followed by the numeric date and year.)

(Surety)

(Signature of authorized representative)

Attest:
(Seal):

(Printed name and title)

Florida Building Code, 8th Edition (2023) - Energy Conservation

EnergyGauge Summit® Fla/Com-2023, Effective Date: Dec 31, 2023

C407: FBC Total Building Performance Compliance Option

Compliance applying the requirements of Sections C402.5, C403.2, C404,C405.2, C405.4, C405.5, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Check List

Applications for compliance with the Florida Building Code, Energy Conservation shall include:

- ☑ The full compliance report generated by the software that contains the project summary, compliance summary, certifications and detailed component compliance reports.
- ☑ The compliance report must include the full input report generated by the software as contigous part of the compliance report.
- ☑ Boxes appropriately checked in the Mandatory Section of the complaince report.

PROJECT SUMMARY

Short Desc:	I22509	**Description:**	THE GULF COAST REHABIL
Owner:			
Address1:	1937 JENKS AVENUE	**City:**	PANAMA CITY
Address2:	PANAMA CITY, FLORIDA	**State:**	FLORIDA
		Zip:	32405
Type:	Healthcare-Clinic	**Class:**	New Finished building
Jurisdiction:	PANAMA CITY, BAY COUNTY, FL (131500)		
Conditioned Area:	66533 SF	**Conditioned & UnConditioned Area:**	67668 SF
No of Stories:	2	**Area entered from Plans**	67668 SF
Permit No:	0	**Max Tonnage**	27.2
		If different, write in:	_____

Compliance Summary

Component	Design	Criteria	Result
Gross Energy Cost (in $)	26563.00	48503.00	**PASSED**
LIGHTING CONTROLS			**PASSES**
EXTERNAL LIGHTING			**PASSES**
HVAC SYSTEM			**PASSES**
PLANT			**No Entry**
WATER HEATING SYSTEMS			**PASSES**
PIPING SYSTEMS			**PASSES**
Met all required compliance from Check List?			**Yes/No/NA**

IMPORTANT MESSAGE
Info 5009 -- -- -- An input report of this design building must be submitted along with this Compliance Report

CERTIFICATIONS

I hereby certify that the plans and specifications covered by this calculation are in compliance with the Florida Energy Code

Prepared By: Eric S. Cepull

Date: 06/06/2024

Building Official: _____

Date: _____

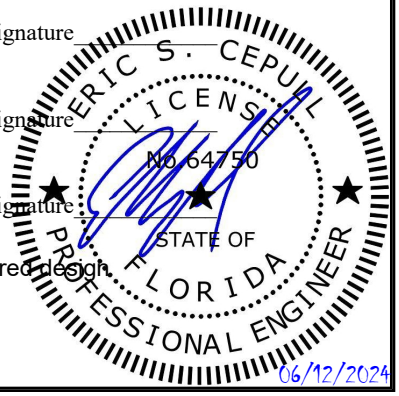
I certify that this building is in compliance with the FLorida Energy Efficiency Code

Owner Agent: _____ Date: _____

If Required by Florida law, I hereby certify (*) that the system design is in compliance with the Florida Energy Efficiency Code

Architect:	_____	Reg No: _____	Signature_____
Electrical Designer:	_____	Reg No: _____	Signature_____
Lighting Designer:	_____	Reg No: _____	Signature_____
Mechanical Designer:	_____	Reg No: _____	Signature_____
Plumbing Designer:	_____	Reg No: _____	Signature_____

(*) Signature is required where Florida Law requires design to be performed by registered design professionals per C103.1.1.1.2



Project: I22509
Title: THE GULF COAST REHABILITATION CENTER
Type: Healthcare-Clinic
(WEA File: FL_PANAMA_CITY_BAY_CO.tm3)

Building End Uses

	1) Proposed	2) Baseline
Total	*1748.40*	*3870.00*
	$26,563	*$57,063*
ELECTRICITY(MBtu/kWh/$)	1678.60	3522.90
	491816	1032226
	$26,214	*$55,327*
AREA LIGHTS	148.60	465.70
	43536	136452
	$2,320	*$7,314*
MISC EQUIPMT	646.70	646.70
	189477	189477
	$10,099	*$10,156*
PUMPS & MISC	8.10	7.20
	2386	2119
	$127	*$114*
SPACE COOL	540.60	771.80
	158384	226145
	$8,442	*$12,121*
SPACE HEAT	122.20	104.00
	35813	30470
	$1,909	*$1,633*
VENT FANS	212.40	1527.50
	62220	447563
	$3,316	*$23,989*
NATURAL-GAS(MBtu/therm/$)	69.80	347.10
	698	3471
	$349	*$1,736*
SPACE HEAT	69.80	347.10
	698	3471
	$349	*$1,736*

Credits Applied: None
Passing Criteria = 48503
Design (including any credits) = 26563
Passing requires Proposed Building cost to be at most 85% of Baseline cost. This Proposed Building is at 46.6%

PASSES

Project: I22509
Title: THE GULF COAST REHABILITATION CENTER
Type: Healthcare-Clinic
(WEA File: FL_PANAMA_CITY_BAY_CO.tm3)

External Lighting Compliance

Description	Category	Tradable?	Allowance (W/Unit)	Area or Length or No. of Units (Sqft or ft)	ELPA (W)	CLP (W)
WE	Canopies (freestanding, attached and Overhangs)	Yes	0.40	100.0	40	20
WE	Walk way less than 10 feet wide	Yes	0.60	100.0	60	40
EX1	Walk way less than 10 feet wide	Yes	0.60	10.0	6	2
WE	Main entries	Yes	21.00	200.0	4,200	20
A	Canopies (freestanding, attached and Overhangs)	Yes	0.40	250.0	100	70
A	Main entries	Yes	21.00			140
WE	Walk way less than 10 feet wide	Yes	0.60	900.0	540	240
G	Main entries	Yes	21.00			15

Tradable Surfaces: 547 (W) Allowance for Tradable: 5446 (W) **PASSES**
All External Lighting: 547 (W)
Complicance check includes a excess/Base allowance of 500.00(W)

Lighting Controls Compliance

Acronym	ID	Description	Area (sq.ft)	Compliance
141 SPEECH THER	17	141 SPEECH THERAPY (Office - Enclosed)	83	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
142 COUNSELING	17	142 COUNSELING (Office - Enclosed)	76	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
143 UNIT MANG.	17	143 UNIT MANG. OFFICE (Office - Enclosed)	76	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
144 HALL.	5	144 HALL (Corridor)	79	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
145 ADMI. OFFICE	17	145 ADMISSIONS OFFICE (Office - Enclosed)	81	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

146 PLAN OFFICE	**17**	**146 PLAN OFFICE (Office - Enclosed)**	**81**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
139 BEAUTY SALC	**8,002**	**139 BEAUTY SALON (Dressing/Locker/Fitting Room (General))**	**188**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
140 SALON TLT	**6**	**140 SALON TLT (Toilet and Washroom)**	**70**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
131 OCUU. THERA	**7**	**131 COCCUPATIONAL THERAPY (Food Service - Kitchen)**	**165**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
124 ADMIN OFFIC	**17**	**124 ADMIN OFFICE (Office - Enclosed)**	**135**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
125 RECEPTION	**12**	**125 RECEPTION (Lobby (General) - Reception and Waiting)**	**132**	COMPLIANCE: PASSES REQUIRED: All of |8|; one of |3| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

126 MEETING RO(	**15**	**126 CARE PLAN MEETING ROOM (Conference/meeting (Multiple Functions))**	**166** COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
128 PUB TLT	**6**	**128 PUB TLT (Toilet and Washroom)**	**58** COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
129 PUB TLT	**6**	**129 PUB TLT (Toilet and Washroom)**	**85** COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
127 MAIL RM.	**3**	**127 MAIL RM. (Storage & Warehouse - Bulky Active Storage)**	**50** COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
121 VESTIBUL	**5**	**121 VESTIBUL (Corridor)**	**113** COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
122 LOBBY	**12**	**122 LOBBY / NORTH AND SOUTH LOBBY (Lobby (General) - Reception and Waiting)**	**512** COMPLIANCE: PASSES REQUIRED: All of |3|; one of |9| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 9-Time-Switch: Auto Full Off or Scheduled Off
123 ELEV. LOBBY	**12**	**123 ELEV. LOBBY (Lobby (General) - Reception and Waiting)**	**732** COMPLIANCE: PASSES REQUIRED: All of |3|; one of |9| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 9-Time-Switch: Auto Full Off or Scheduled Off

130 PHYSCIAL TH	**10,004**	**130 PHYSCICAL THERPAY-UPPER (Exam/Treatment (Hospital))**	**742**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
130 PHYSCIAL TH	**10,004**	**130 PHYSCICAL THERPAY-UPPER (Exam/Treatment (Hospital))**	**792**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
152B CORRIDOR	**5**	**152B CORRIDOR (Corridor)**	**755**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
133 PHYSCIAL TH	**10,004**	**133 PHYSCICAL THERPAY (Exam/Treatment (Hospital))**	**268**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
134 PT. RECEPTIO	**12**	**134 PT. RECEPTION (Lobby (General) - Reception and Waiting)**	**128**	COMPLIANCE: PASSES REQUIRED: All of |8|; one of |3| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
135 INDIVIDUAL T	**10,004**	**135 INDIVIDUAL TREATMENT (Exam/Treatment (Hospital))**	**118**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

137 TRAT. ROOM	**10,004**	**137 TRAT. ROOM (Exam/Treatment (Hospital))**	**119**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
138 EXAM ROOM	**10,004**	**138 EXAM ROOM (Exam/Treatment (Hospital))**	**99**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
136 HALL	**5**	**136 HALL (Corridor)**	**83**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
154 CONFERENCE	**15**	**154 CONFERENCE ROOM (Conference/meeting (Multiple Functions))**	**336**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
153 P.T STORAGE	**3**	**153 P.T STORAGE (Storage & Warehouse - Bulky Active Storage)**	**212**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
147 ACC. OFFICE	**16**	**147 ACC. OFFICE (Office - Open Plan)**	**74**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |3|; one of |8|9| CONTROLS IN SPACE: 1-Manual (Local Control) 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF 9-Time-Switch: Auto Full Off or Scheduled Off

148 BOOKING OFI	**16**	**148 BOOKING OFFICE (Office - Open Plan)**	**74**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |3|; one of |8|9| CONTROLS IN SPACE: 1-Manual (Local Control) 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF 9-Time-Switch: Auto Full Off or Scheduled Off
151 COPY ROOM	**1**	**151 COPY ROOM (Electrical Mechanical Equipment Room - General)**	**47**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
150 WORK ROOM	**16**	**150 WORK ROOM (Office - Open Plan)**	**68**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |3|; one of |8|9| CONTROLS IN SPACE: 1-Manual (Local Control) 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF 9-Time-Switch: Auto Full Off or Scheduled Off
149 HALL	**5**	**149 HALL (Corridor)**	**67**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
155 MEDICAL REC	**3**	**155 MEDICAL RECORDS (Storage & Warehouse - Bulky Active Storage)**	**251**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
156 RESIDENT ST(	**3**	**156 RESIDENT STORAGE (Storage & Warehouse - Bulky Active Storage)**	**504**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

158 FACILITY STO	**3**	**158 FACILITY STORAGE (Storage & Warehouse - Bulky Active Storage)**	**214**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
162 CENTRAL SUP	**1**	**162 CENTRAL SUPPLY (Electrical Mechanical Equipment Room - General)**	**276**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
163 MAIN. EQUI/SI	**1**	**163 MAIN. EQUI/SPLY (Electrical Mechanical Equipment Room - General)**	**285**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
152 CORRIDOR	**5**	**152/152A CORRIDOR (Corridor)**	**1,088**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
159 STAFF LOUNG	**9**	**159 STAFF LOUNGH (Food Service - Bar/Lounge)**	**298**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
160 STAFF TLT	**6**	**160 STAFF TLT (Toilet and Washroom)**	**57**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

161 STAFF TLT	**6**	**161 STAFF TLT (Toilet and Washroom)**	**57**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
165 DINING	**8**	**165 DINING WITH DINING NORTH AND SOUTH (Food Service - Leisure Dining)**	**881**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
175 STORAGE	**3**	**175 STORAGE (Storage & Warehouse - Bulky Active Storage)**	**71**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
178 STAFFT TLT	**6**	**178 STAFFT TLT (Toilet and Washroom)**	**50**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
179 STAFFT TLT	**6**	**179 STAFFT TLT (Toilet and Washroom)**	**50**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
170 HOUSE. OFFIC	**17**	**170 HOUSEKEEPING OFFICE (Office - Enclosed)**	**83**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

171 MAINT. OFFIC	**17**	**171 MAINT. OFFICE (Office - Enclosed)**	**109**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
185 LAUNDRY	**10,012**	**185 LAUNDRY (Laundry-Washing)**	**312**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%) 9-Time-Switch: Auto Full Off or Scheduled Off
186 HOLDING ARI	**3**	**186 HOLDING AREA (Storage & Warehouse - Bulky Active Storage)**	**87**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
172 SERVICE COR	**5**	**172 SERVICE CORRIDOR (Corridor)**	**427**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
183 SORTING /FOI	**3**	**183 SORTING /FOLDING (Storage & Warehouse - Bulky Active Storage)**	**152**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
184 LAUNDRY	**10,012**	**184 LAUNDRY (Laundry-Washing)**	**214**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

177 CENTRAL CLI	**3**	**177 CENTRAL CLEAN (Storage & Warehouse - Bulky Active Storage)**	**69**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
173 SOLID HOLDI	**3**	**173 SOLID HOLDING (Storage & Warehouse - Bulky Active Storage)**	**69**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
174 WASTE MANA	**3**	**174 WASTE MANAGEMENT (Storage & Warehouse - Bulky Active Storage)**	**73**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
187B CORRIDOR	**5**	**187B CORRIDOR (Corridor)**	**584**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
187A CORRIDOR	**5**	**187A CORRIDOR (Corridor)**	**725**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
189 CLEAN UTILI	**3**	**189 CLEAN UTILITY (Storage & Warehouse - Bulky Active Storage)**	**87**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

190 SOLIED UTILI	**3**	**190 SOLIED UTILITY (Storage & Warehouse - Bulky Active Storage)**	**77**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
191 SECURE STOR	**3**	**191 SECURE STORAGE (Storage & Warehouse - Bulky Active Storage)**	**66**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
192 DON OFFICE	**17**	**192 DON OFFICE (Office - Enclosed)**	**134**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
187C CORRIDOR	**5**	**187C CORRIDOR (Corridor)**	**996**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
194 NURSE STATI	**10,003**	**194 NURSE STATION (Nurse Station (Hospital))**	**133**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
197 STAFF TLT	**6**	**197 STAFF TLT (Toilet and Washroom)**	**49**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

196 MED RM	**3**	**196 MED RM (Storage & Warehouse - Bulky Active Storage)**	**54**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
195 NOURISH	**9**	**195 NOURISH (Food Service - Bar/Lounge)**	**54**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
198 ACTIVITY RO	**9,001**	**198 ACTIVITY ROOM (Playing Area)**	**445**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2|; one of |8|9| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%) 8-Occupant Sensor Auto Full OFF 9-Time-Switch: Auto Full Off or Scheduled Off
164 COM. KITCHE	**7**	**164 COMMERCIAL KITCHEN UPPER (Food Service - Kitchen)**	**141**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
167 DIETARY OFF	**17**	**167 DIETARY OFFICE (Office - Enclosed)**	**73**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

164 COM. KITCHE	**7**	**164 COMMERCIAL KITCHEN LOWER (Food Service - Kitchen)**	**602**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%) 9-Time-Switch: Auto Full Off or Scheduled Off
164B DRY STORAC	**3**	**164B DRY STORAGE (Storage & Warehouse - Bulky Active Storage)**	**142**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
244 CAREPLAN M	**15**	**244 CAREPLAN MEETING (Conference/meeting (Multiple Functions))**	**204**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
245 ADON OFFICE	**17**	**245 ADON OFFICE (Office - Enclosed)**	**74**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
249 CORRIDOR	**5**	**249 CORRIDOR (Corridor)**	**447**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
249B CORRIDOR	**5**	**249B CORRIDOR (Corridor)**	**735**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

243 ELEV LOBBY	**5**	**243 ELEV LOBBY (Corridor)**	**116**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
249A CORRIDOR	**5**	**249A CORRIDOR (Corridor)**	**981**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
252 ACTIVITY RO(	**9,001**	**252 ACTIVITY ROOM (Playing Area)**	**219**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
255 SERVICE STA(	**5**	**255 SERVICE STAGING (Corridor)**	**433**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
254 WARMIMG KI	**7**	**254 WARMIMG KITCHEN (Food Service - Kitchen)**	**442**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%) 9-Time-Switch: Auto Full Off or Scheduled Off
253 DINING	**8**	**253 DINING (Food Service - Leisure Dining)**	**914**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

WALKING AIDS	**8**	**WALKING AIDS (Food Service - Leisure Dining)**	**76**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
262 CORRIDOR	**5**	**262 CORRIDOR (Corridor)**	**726**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
262A CORRIDOR	**5**	**262A CORRIDOR (Corridor)**	**699**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
259 CLEAN UTILI	**3**	**259 CLEAN UTILITY (Storage & Warehouse - Bulky Active Storage)**	**87**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
260 SOLIED UTILI	**3**	**1260 SOLIED UTILITY (Storage & Warehouse - Bulky Active Storage)**	**76**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
ASSISTED TLT 261	**6**	**ASSISTED TLT 261B (Toilet and Washroom)**	**63**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

264 NURSE STATI(	**10,003**	**264 NURSE STATION (Nurse Station (Hospital))**	**133**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
267 STAFF TLT	**6**	**267 STAFF TLT (Toilet and Washroom)**	**49**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
266 MED RM	**3**	**266 MED RM (Storage & Warehouse - Bulky Active Storage)**	**54**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
265 NOURISH	**9**	**265 NOURISH (Food Service - Bar/Lounge)**	**54**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
262B CORRIDOR	**5**	**262B CORRIDOR (Corridor)**	**983**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
268 ACTIVITY RO(	**9,001**	**268 ACTIVITY ROOM (Playing Area)**	**600**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2|; one of |8|9| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%) 8-Occupant Sensor Auto Full OFF 9-Time-Switch: Auto Full Off or Scheduled Off

180A MAIN ELEC.	**1**	**180A MAIN ELEC. (Electrical Mechanical Equipment Room - General)**	**179**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
180B MAIN ELEC.	**1**	**180B MAIN ELEC. (Electrical Mechanical Equipment Room - General)**	**169**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
176 TELE-COM	**1**	**176 TELE-COM (Electrical Mechanical Equipment Room - General)**	**104**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
169 ELEV. EQUIP	**1**	**169 ELEV. EQUIP (Electrical Mechanical Equipment Room - General)**	**99**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
199 ELEC EQUIP.	**1**	**199 ELEC EQUIP. (Electrical Mechanical Equipment Room - General)**	**252**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

257 ELEC ROOM	**1**	**257 ELEC ROOM (Electrical Mechanical Equipment Room - General)**	**96**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
256 ELEC ROOM	**1**	**256 ELEC ROOM (Electrical Mechanical Equipment Room - General)**	**109**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**321**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**321**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**393**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**410**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)

SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**306**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**333**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**361**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**321**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**321**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**321**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)

SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**335**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**427**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**326**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**315**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**331**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**365**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)

SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**395**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**333**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**361**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**412**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
SEMI PRV	**10,006**	**SEMI PRV (Patient Room (Hospital))**	**306**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
PRIVATE	**10,006**	**PRIVATE (Patient Room (Hospital))**	**329**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)

PRIVATE	**10,006**	**PRIVATE (Patient Room (Hospital))**	**336**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
PRIVATE	**10,006**	**PRIVATE (Patient Room (Hospital))**	**277**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
141 SPEECH THEF	**17**	**141 SPEECH THERAPY (Office - Enclosed)**	**36**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
142 COUNSELING	**17**	**142 COUNSELING (Office - Enclosed)**	**33**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
143 UNIT MANG.	**17**	**143 UNIT MANG. OFFICE (Office - Enclosed)**	**24**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
144 HALL.	**5**	**144 HALL (Corridor)**	**35**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

145 ADMI. OFFICE	**17**	**145 ADMISSIONS OFFICE (Office - Enclosed)**	**81**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
146 PLAN OFFICE	**17**	**146 PLAN OFFICE (Office - Enclosed)**	**81**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
139 BEAUTY SALC	**8,002**	**139 BEAUTY SALON (Dressing/Locker/Fitting Room (General))**	**80**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
140 SALON TLT	**6**	**140 SALON TLT (Toilet and Washroom)**	**30**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
131 OCUU. THERA	**7**	**131 COCCUPATIONAL THERAPY (Food Service - Kitchen)**	**71**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
124 ADMIN OFFIC	**17**	**124 ADMIN OFFICE (Office - Enclosed)**	**58**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

125 RECEPTION	**12**	**125 RECEPTION (Lobby (General) - Reception and Waiting)**	**56**	COMPLIANCE: PASSES REQUIRED: All of |8|; one of |3| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
126 MEETING RO(	**15**	**126 CARE PLAN MEETING ROOM (Conference/meeting (Multiple Functions))**	**71**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
128 PUB TLT	**6**	**128 PUB TLT (Toilet and Washroom)**	**25**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
129 PUB TLT	**6**	**129 PUB TLT (Toilet and Washroom)**	**25**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
127 MAIL RM.	**3**	**127 MAIL RM. (Storage & Warehouse - Bulky Active Storage)**	**22**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
121 VESTIBUL	**5**	**121 VESTIBUL (Corridor)**	**49**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
122 LOBBY	**12**	**122 LOBBY / NORTH AND SOUTH LOBBY (Lobby (General) - Reception and Waiting)**	**220**	COMPLIANCE: PASSES REQUIRED: All of |8|; one of |3| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

123 ELEV. LOBBY	**12**	**123 ELEV. LOBBY (Lobby (General) - Reception and Waiting)**	**314**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |9| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 9-Time-Switch: Auto Full Off or Scheduled Off
130 PHYSCIAL TH	**10,004**	**130 PHYSCICAL THERPAY-UPPER (Exam/Treatment (Hospital))**	**318**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
130 PHYSCIAL TH	**10,004**	**130 PHYSCICAL THERPAY-UPPER (Exam/Treatment (Hospital))**	**340**	COMPLIANCE: PASSES REQUIRED: All of |1|4|; one of |2| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 4-Light Reduction (30%-70%)
152B CORRIDOR	**5**	**152B CORRIDOR (Corridor)**	**324**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
133 PHYSCIAL TH	**10,004**	**133 PHYSCICAL THERPAY (Exam/Treatment (Hospital))**	**115**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
134 PT. RECEPTIO	**12**	**134 PT. RECEPTION (Lobby (General) - Reception and Waiting)**	**55**	COMPLIANCE: PASSES REQUIRED: All of |8|; one of |3| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

135 INDIVIDUAL T	**10,004**	**135 INDIVIDUAL TREATMENT (Exam/Treatment (Hospital))**	**51**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
137 TRAT. ROOM	**10,004**	**137 TRAT. ROOM (Exam/Treatment (Hospital))**	**51**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
138 EXAM ROOM	**10,004**	**138 EXAM ROOM (Exam/Treatment (Hospital))**	**43**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
136 HALL	**5**	**136 HALL (Corridor)**	**35**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
154 CONFERENCE	**15**	**154 CONFERENCE ROOM (Conference/meeting (Multiple Functions))**	**144**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
153 P.T STORAGE	**3**	**153 P.T STORAGE (Storage & Warehouse - Bulky Active Storage)**	**91**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

244 CAREPLAN M	**15**	**244 CAREPLAN MEETING (Conference/meeting (Multiple Functions))**	**88**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
245 ADON OFFICE	**17**	**245 ADON OFFICE (Office - Enclosed)**	**32**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
249 CORRIDOR	**5**	**249 CORRIDOR (Corridor)**	**192**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
249B CORRIDOR	**5**	**249B CORRIDOR (Corridor)**	**328**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
243 ELEV LOBBY	**5**	**243 ELEV LOBBY (Corridor)**	**50**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
SEMI PRV-458	**10,006**	**SEMI PRV-458 L2 (Patient Room (Hospital))**	**137**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

SEMI PRV-478	**10,006**	**SEMI PRV-478_L2 (Patient Room (Hospital))**	**143**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-610	**10,006**	**SEMI PRV-610_L2 (Patient Room (Hospital))**	**183**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
PRIVATE-395	**10,006**	**PRIVATE-395_L2 (Patient Room (Hospital))**	**277**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
PRIVATE-480	**10,006**	**PRIVATE-480_L2 (Patient Room (Hospital))**	**144**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
PRIVATE-470	**10,006**	**PRIVATE-470 (Patient Room (Hospital))**	**141**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

147 ACC. OFFICE	**16**	**147 ACC. OFFICE (Office - Open Plan)**	**32**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |3|; one of |8|9| CONTROLS IN SPACE: 1-Manual (Local Control) 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF 9-Time-Switch: Auto Full Off or Scheduled Off
148 BOOKING OFI	**16**	**148 BOOKING OFFICE (Office - Open Plan)**	**32**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |3|; one of |8|9| CONTROLS IN SPACE: 1-Manual (Local Control) 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF 9-Time-Switch: Auto Full Off or Scheduled Off
151 COPY ROOM	**1**	**151 COPY ROOM (Electrical Mechanical Equipment Room - General)**	**20**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
150 WORK ROOM	**16**	**150 WORK ROOM (Office - Open Plan)**	**29**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |3|; one of |8|9| CONTROLS IN SPACE: 1-Manual (Local Control) 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF 9-Time-Switch: Auto Full Off or Scheduled Off
149 HALL	**5**	**149 HALL (Corridor)**	**29**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
155 MEDICAL REC	**3**	**155 MEDICAL RECORDS (Storage & Warehouse - Bulky Active Storage)**	**107**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

156 RESIDENT ST(	**3**	**156 RESIDENT STORAGE (Storage & Warehouse - Bulky Active Storage)**	**216**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
158 FACILITY STC	**3**	**158 FACILITY STORAGE (Storage & Warehouse - Bulky Active Storage)**	**92**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
162 CENTRAL SUP	**1**	**162 CENTRAL SUPPLY (Electrical Mechanical Equipment Room - General)**	**118**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
163 MAIN. EQUI/SI	**1**	**163 MAIN. EQUI/SPLY (Electrical Mechanical Equipment Room - General)**	**122**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
159 STAFF LOUNG	**9**	**159 STAFF LOUNGH (Food Service - Bar/Lounge)**	**128**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
160 STAFF TLT	**6**	**160 STAFF TLT (Toilet and Washroom)**	**24**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

161 STAFF TLT	**6**	**161 STAFF TLT (Toilet and Washroom)**	**24**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
165 DINING	**8**	**165 DINING WITH DINING NORTH AND SOUTH (Food Service - Leisure Dining)**	**378**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
164 COM. KITCHE	**8**	**164 COMMERCIAL KITCHEN UPPER (Food Service - Leisure Dining)**	**141**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
167 DIETARY OFF	**17**	**167 DIETARY OFFICE (Office - Enclosed)**	**31**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
164 COM. KITCHE	**8**	**164 COMMERCIAL KITCHEN LOWER (Food Service - Leisure Dining)**	**258**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
164B DRY STORAG	**3**	**164B DRY STORAGE (Storage & Warehouse - Bulky Active Storage)**	**61**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

249A CORRIDOR	**5**	**249A CORRIDOR (Corridor)**	**420**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
252 ACTIVITY RO	**9,001**	**252 ACTIVITY ROOM (Playing Area)**	**94**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-458	**10,006**	**SEMI PRV-458_L2 (Patient Room (Hospital))**	**137**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-478	**10,006**	**SEMI PRV-478 L2 (Patient Room (Hospital))**	**143**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-473	**10,006**	**SEMI PRV-473 L2 (Patient Room (Hospital))**	**142**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-451	**10,006**	**SEMI PRV-451 L2 (Patient Room (Hospital))**	**135**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

SEMI PRV-465	**10,006**	**SEMI PRV-465 L2 (Patient Room (Hospital))**	**140**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
152 CORRIDOR	**5**	**152/152A CORRIDOR (Corridor)**	**466**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
175 STORAGE	**3**	**175 STORAGE (Storage & Warehouse - Bulky Active Storage)**	**71**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
178 STAFFT TLT	**3**	**178 STAFFT TLT (Storage & Warehouse - Bulky Active Storage)**	**50**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
179 STAFFT TLT	**3**	**179 STAFFT TLT (Storage & Warehouse - Bulky Active Storage)**	**21**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
170 HOUSE. OFFIC	**17**	**170 HOUSEKEEPING OFFICE (Office - Enclosed)**	**36**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

171 MAINT. OFFIC	**17**	**171 MAINT. OFFICE (Office - Enclosed)**	**47**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
185 LAUNDRY	**10,012**	**185 LAUNDRY (Laundry-Washing)**	**134**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
186 HOLDING ARI	**3**	**186 HOLDING AREA (Storage & Warehouse - Bulky Active Storage)**	**37**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
172 SERVICE COR	**5**	**172 SERVICE CORRIDOR (Corridor)**	**183**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
183 SORTING /FOI	**3**	**183 SORTING /FOLDING (Storage & Warehouse - Bulky Active Storage)**	**65**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
184 LAUNDRY	**10,012**	**184 LAUNDRY (Laundry-Washing)**	**92**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

177 CENTRAL CLI	**3**	**177 CENTRAL CLEAN (Storage & Warehouse - Bulky Active Storage)**	**29**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
173 SOLID HOLDI	**3**	**173 SOLID HOLDING (Storage & Warehouse - Bulky Active Storage)**	**29**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
174 WASTE MANA	**3**	**174 WASTE MANAGEMENT (Storage & Warehouse - Bulky Active Storage)**	**31**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
187B CORRIDOR	**5**	**187B CORRIDOR (Corridor)**	**250**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
187A CORRIDOR	**5**	**187A CORRIDOR (Corridor)**	**311**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
189 CLEAN UTILI	**3**	**189 CLEAN UTILITY (Storage & Warehouse - Bulky Active Storage)**	**37**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

190 SOLIED UTILI	**3**	**190 SOLIED UTILITY (Storage & Warehouse - Bulky Active Storage)**	**33**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
191 SECURE STOR	**3**	**191 SECURE STORAGE (Storage & Warehouse - Bulky Active Storage)**	**28**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
192 DON OFFICE	**17**	**192 DON OFFICE (Office - Enclosed)**	**58**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
255 SERVICE STAG	**5**	**255 SERVICE STAGING (Corridor)**	**186**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
254 WARMIMG KI	**7**	**254 WARMIMG KITCHEN (Food Service - Kitchen)**	**190**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
253 DINING	**8**	**253 DINING (Food Service - Leisure Dining)**	**392**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

WALKING AIDS	**8**	**WALKING AIDS (Food Service - Leisure Dining)**	**32**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
262 CORRIDOR	**5**	**262 CORRIDOR (Corridor)**	**311**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
262A CORRIDOR	**5**	**262A CORRIDOR (Corridor)**	**300**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
259 CLEAN UTILI	**3**	**259 CLEAN UTILITY (Storage & Warehouse - Bulky Active Storage)**	**37**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
260 SOLIED UTILI	**3**	**1260 SOLIED UTILITY (Storage & Warehouse - Bulky Active Storage)**	**33**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
ASSISTED TLT 261	**6**	**ASSISTED TLT 261B (Toilet and Washroom)**	**27**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

SEMI PRV-458	**10,006**	**SEMI PRV-458_L1 (Patient Room (Hospital))**	**137**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-458	**10,006**	**SEMI PRV-458_L1 (Patient Room (Hospital))**	**137**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-562	**10,006**	**SEMI PRV-562_L1 (Patient Room (Hospital))**	**169**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-458	**10,006**	**SEMI PRV-458_L2 (Patient Room (Hospital))**	**137**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-521	**10,006**	**SEMI PRV-521_L2 (Patient Room (Hospital))**	**156**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-564	**10,006**	**SEMI PRV-564_L2 (Patient Room (Hospital))**	**169**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

187C CORRIDOR	**5**	**187C CORRIDOR (Corridor)**	**427**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
194 NURSE STATI(	**10,003**	**194 NURSE STATION (Nurse Station (Hospital))**	**57**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
197 STAFF TLT	**6**	**197 STAFF TLT (Toilet and Washroom)**	**21**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
196 MED RM	**3**	**196 MED RM (Storage & Warehouse - Bulky Active Storage)**	**23**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
195 NOURISH	**9**	**195 NOURISH (Food Service - Bar/Lounge)**	**23**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
198 ACTIVITY RO(	**9,001**	**198 ACTIVITY ROOM (Playing Area)**	**191**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

264 NURSE STATI(	**10,003**	**264 NURSE STATION (Nurse Station (Hospital))**	**57**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
267 STAFF TLT	**6**	**267 STAFF TLT (Toilet and Washroom)**	**21**	COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
266 MED RM	**3**	**266 MED RM (Storage & Warehouse - Bulky Active Storage)**	**23**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
265 NOURISH	**9**	**265 NOURISH (Food Service - Bar/Lounge)**	**23**	COMPLIANCE: PASSES REQUIRED: All of |1|; one of |2|3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
262B CORRIDOR	**5**	**262B CORRIDOR (Corridor)**	**421**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
268 ACTIVITY RO(	**9,001**	**268 ACTIVITY ROOM (Playing Area)**	**257**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

SEMI PRV-476	**10,006**	**SEMI PRV-476_L1 (Patient Room (Hospital))**	**143**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-458	**10,006**	**SEMI PRV-458_L1 (Patient Room (Hospital))**	**137**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-516	**10,006**	**SEMI PRV-516_L1 (Patient Room (Hospital))**	**155**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-586	**10,006**	**SEMI PRV-586_L1 (Patient Room (Hospital))**	**176**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-437	**10,006**	**SEMI PRV-437_L1 (Patient Room (Hospital))**	**131**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

SEMI PRV-476	**10,006**	**SEMI PRV-476_L2 (Patient Room (Hospital))**	**143**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-458	**10,006**	**SEMI PRV-458_L2 (Patient Room (Hospital))**	**137**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-516	**10,006**	**SEMI PRV-516_L2 (Patient Room (Hospital))**	**155**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-586	**10,006**	**SEMI PRV-586_L1 (Patient Room (Hospital))**	**176**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SEMI PRV-437	**10,006**	**SEMI PRV-437_L1 (Patient Room (Hospital))**	**131**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
STAIR-132	**4**	**STAIR-132 (Stair - Active Traffic)**	**200**	COMPLIANCE: PASSES REQUIRED: All of |8|; one of |3| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

STAIR-157	**4**	**STAIR-157 (Stair - Active Traffic)**	**200**	COMPLIANCE: PASSES REQUIRED: All of |8|; one of |3| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
STAIR-187	**4**	**STAIR-187 (Stair - Active Traffic)**	**229**	COMPLIANCE: PASSES REQUIRED: All of |8|; one of |3| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
STAIR-193	**4**	**STAIR-193 (Stair - Active Traffic)**	**200**	COMPLIANCE: PASSES REQUIRED: All of |8|; one of |3| CONTROLS IN SPACE: 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
SUPPLY-136A	**1**	**SUPPLY-136A (Electrical Mechanical Equipment Room - General)**	**31**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
164 KITCHEN STO	**3**	**164 KITCHEN STORAGE (Storage & Warehouse - Bulky Active Storage)**	**136**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
167A SECURE STO	**3**	**167A SECURE STORAGE (Storage & Warehouse - Bulky Active Storage)**	**29**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
164 KITCHEN HAI	**5**	**164 KITCHEN HALL (Corridor)**	**67**	COMPLIANCE: PASSES REQUIRED: All of |7|; one of |9| CONTROLS IN SPACE: 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

188 FIRE RISER	**3**	**188 FIRE RISER (Storage & Warehouse - Bulky Active Storage)**	**52**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
193A/193B ELEC	**1**	**193A/193B ELECTRICAL (Electrical Mechanical Equipment Room - General)**	**24**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
193B CL. LINEN	**3**	**193B CL. LINEN (Storage & Warehouse - Bulky Active Storage)**	**24**	COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
193C COMM	**1**	**193C COMM (Electrical Mechanical Equipment Room - General)**	**24**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
248C COMM	**1**	**248C/258C COMM (Electrical Mechanical Equipment Room - General)**	**24**	COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF

248D/258A/258D EI	**1**	**248D/258A/258D ELECTRICAL (Electrical Mechanical Equipment Room - General)**	**24** COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
258B CL. LINEN	**3**	**258B CL. LINEN (Storage & Warehouse - Bulky Active Storage)**	**24** COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off
261A SHOWER	**6**	**261A ASSISTED SHOWER (Toilet and Washroom)**	**192** COMPLIANCE: PASSES REQUIRED: All of |3|; one of |8| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
182 WATER HEATI	**1**	**182 WATER HEATER (Electrical Mechanical Equipment Room - General)**	**144** COMPLIANCE: PASSES REQUIRED: All of |1|8|; one of |2|3| CONTROLS IN SPACE: 1-Manual (Local Control) 2-Occupancy Sensor - Manual ON only 3-Occupant Sensor (50%) 8-Occupant Sensor Auto Full OFF
250 FIRE RISER	**3**	**250 FIRE RISER (Storage & Warehouse - Bulky Active Storage)**	**52** COMPLIANCE: PASSES REQUIRED: All of |1|7|; one of |9| CONTROLS IN SPACE: 1-Manual (Local Control) 7-Occupant Sensor Auto OFF (Full or Partial) 9-Time-Switch: Auto Full Off or Scheduled Off

PASSES

Project: I22509
Title: THE GULF COAST REHABILITATION CENTER
Type: Healthcare-Clinic
(WEA File: FL_PANAMA_CITY_BAY_CO.tm3)

System Report Compliance

FCU-1.1 **FCU-1.1** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	20800	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	28000	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	590	0.39	0.82			**PASSES**

FCU-1.2 **FCU-1.2** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	19600	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	28000	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	350	0.60	0.82			**PASSES**

FCU-1.3 **FCU-1.3** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12300	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	17700	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	230	0.59	0.82			**PASSES**

FCU-1.4	FCU-1.4			Constant Volume Air Cooled Split System < 65000 Btu/hr			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	15700	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	20900	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	600	0.38	0.82			**PASSES**

FCU-1.5	FCU-1.5			Constant Volume Air Cooled Split System < 65000 Btu/hr			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	41300	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	56100	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	1280	0.23	0.82			**PASSES**

FCU-1.6	FCU-1.6			Constant Volume Air Cooled Split System < 65000 Btu/hr			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	33	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	41500	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	1065	0.28	0.82			**PASSES**

FCU-1.7	FCU-1.7			Constant Volume Air Cooled Split System < 65000 Btu/hr			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	33	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	41500	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	1065	0.28	0.82			**PASSES**

FCU-1.8	FCU-1.8			Constant Volume Air Cooled Split System < 65000 Btu/hr			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	13500	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	17700	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	420	0.30	0.82			**PASSES**

FCU-1.9	FCU-1.9			Constant Volume Air Cooled Split System < 65000 Btu/hr			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	8100	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	10900	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	300	0.26	0.82			**PASSES**

FCU-1.10 **FCU-1.10** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	14900	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	20900	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	495	0.46	0.82			**PASSES**

FCU-1.11 **FCU-1.11** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	21400	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	28000	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	580	0.39	0.82			**PASSES**

FCU-1.12 **FCU-1.12** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	13100	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	17700	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	430	0.30	0.82			**PASSES**

FCU-1.13 **FCU-1.13** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	33700	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	41500	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	935	0.32	0.82			**PASSES**

FCU-1.14 **FCU-1.14** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	19600	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	28000	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	610	0.49	0.82			**PASSES**

FCU-1.15 **FCU-1.15** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	32000	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	41500	10.73	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	1000	0.23	0.82			**PASSES**

FCU-1.16	FCU-1.16	Constant Volume Air Cooled Split System < 65000 Btu/hr	No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	13300	14.30	14.30	8.00		PASSES
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	17600	11.60	7.50			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	350	0.37	0.82			PASSES

FCU-1.17	FCU-1.17	Constant Volume Air Cooled Split System < 65000 Btu/hr	No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	29800	14.30	14.30	8.00		PASSES
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	41500	11.60	7.50			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	895	0.25	0.82			PASSES

FCU-1.18	FCU-1.18	Constant Volume Air Cooled Split System < 65000 Btu/hr	No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	33700	14.30	14.30	8.00		PASSES
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	41500	11.60	7.50			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	935	0.30	0.82			PASSES

FCU-1.19 **FCU-1.19** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	13100	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	17700	10.15	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	420	0.30	0.82			**PASSES**

FCU-1.20 **FCU-1.20** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12700	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	17700	10.15	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	355	0.36	0.82			**PASSES**

FCU-1.21 **FCU-1.21** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Compliance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	21400	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	30000	10.15	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	560	0.40	0.82			**PASSES**

FCU-1.22A	FCU-1.22A	Constant Volume Air Cooled Split System < 65000 Btu/hr	No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System 45000 - 65000 Btu/h Cooling Capacity	61700	14.30	13.80	8.00		PASSES
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	46000	10.73	7.50			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	1560	0.48	0.82			PASSES

FCU-1.22B	FCU-1.22B	Constant Volume Air Cooled Split System < 65000 Btu/hr	No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System 45000 - 65000 Btu/h Cooling Capacity	61700	14.30	13.80	8.00		PASSES
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	46000	10.73	7.50			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	1560	0.48	0.82			PASSES

FCU-2.1	FCU-2.1	Constant Volume Air Cooled Split System < 65000 Btu/hr	No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	21600	14.30	14.30	8.00		PASSES
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	28000	10.15	7.50			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	630	0.36	0.82			PASSES

FCU-2.2	FCU-2.2		Constant Volume Air Cooled Split System < 65000 Btu/hr				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	21800	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	28000	10.15	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	630	0.36	0.82			**PASSES**

FCU-2.3	FCU-2.3		Constant Volume Air Cooled Split System < 65000 Btu/hr				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	13500	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	17600	10.15	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	420	0.30	0.82			**PASSES**

FCU-2.4	FCU-2.4		Constant Volume Air Cooled Split System < 65000 Btu/hr				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	33700	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	41500	10.15	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	560	0.50	0.82			**PASSES**

FCU-2.5	FCU-2.5		Constant Volume Packaged System				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled 65000 - 135000 Btu/h Cooling Capacity	72700	12.50	11.20	14.80	14.80	**PASSES**
Heating System	Electric Furnace	84000	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	1500	0.80	0.82			**PASSES**

FCU-2.6	FCU-2.6		Constant Volume Air Cooled Split System < 65000 Btu/hr				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System 45000 - 65000 Btu/h Cooling Capacity	57600	14.30	13.80	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	65600	11.02	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	1450	0.24	0.82			**PASSES**

FCU-2.7	FCU-2.7		Constant Volume Air Cooled Split System < 65000 Btu/hr				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	13400	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	17700	11.02	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	460	0.28	0.82			**PASSES**

FCU-2.8	FCU-2.8		Constant Volume Air Cooled Split System < 65000 Btu/hr				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**

Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12800	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	17700	10.15	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	365	0.35	0.82			**PASSES**

FCU-2.9 **FCU-2.9** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	21400	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	30000	10.15	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	420	0.30	0.82			**PASSES**

FCU-2.10 **FCU-2.10** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	32700	14.30	14.30	8.00		**PASSES**
Heating System	Heat Pumps Air Cooled (Heating Mode) Split System < 65000 Btu/h Cooling Capacity	41500	10.15	7.50			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	700	0.48	0.82			**PASSES**

AC-1.1 **AC-1.1** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12000	14.30	14.30	8.00		**PASSES**

Air Handling System -Supply	Air Handler (Supply) - Constant Volume	250	0.10	0.82			**PASSES**

AC-1.2 **AC-1.2** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12000	14.30	14.30	8.00		**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	250	0.10	0.82			**PASSES**

AC-1.3 **AC-1.3** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12000	14.30	14.30	8.00		**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	250	0.10	0.82			**PASSES**

AC-1.4 **AC-1.4** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12000	14.30	14.30	8.00		**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	250	0.10	0.82			**PASSES**

AC-1.5 **AC-1.5** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. of Units 1**

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12000	14.30	14.30	8.00		**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	250	0.10	0.82			**PASSES**

AC-2.1	AC-2.1	Constant Volume Air Cooled Split System < 65000 Btu/hr	No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12000	14.30	14.30	8.00		PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	250	0.10	0.82			PASSES

AC-2.2	AC-2.2	Constant Volume Air Cooled Split System < 65000 Btu/hr	No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	Air Conditioners Air Cooled Split System < 45000 Btu/h Cooling Capacity	12000	14.30	14.30	8.00		PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	250	0.10	0.82			PASSES

FCU-A/ AREA-458 L1	FCU-A/ AREA-458	Variable refrigerant Flow System	No. of Units 6

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		PASSES
Heating System	Electric Furnace	8900	1.00	1.00			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			PASSES

FCU-A/ AREA-458 L1	FCU-A/ AREA-458	Variable refrigerant Flow System	No. of Units 6

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		PASSES
Heating System	Electric Furnace	8900	1.00	1.00			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			PASSES

FCU-A/ AREA-562 L1	FCU-A/ AREA-562			Variable refrigerant Flow System			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-586 L1	FCU-A/ AREA-586			Variable refrigerant Flow System			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-437 L1	FCU-A/ AREA-437			Variable refrigerant Flow System			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-476 L1	FCU-A/ AREA-476			Variable refrigerant Flow System			No. of Units 2
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-516 L1	FCU-A/ AREA-516		Variable refrigerant Flow System				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-458 L2	FCU-A/ AREA-458		Variable refrigerant Flow System				No. of Units 8
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-458 L2	FCU-A/ AREA-458		Variable refrigerant Flow System				No. of Units 8
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-458 L2	FCU-A/ AREA-458		Variable refrigerant Flow System				No. of Units 7
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-478 L2	FCU-A/ AREA-478			Variable refrigerant Flow System			No. of Units 4
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-610 L2	FCU-A/ AREA-610			Variable refrigerant Flow System			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-465 L2	FCU-A/ AREA-465			Variable refrigerant Flow System			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-451 L2	FCU-A/ AREA-451			Variable refrigerant Flow System			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-473 L2	FCU-A/ AREA-473			Variable refrigerant Flow System			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-521 L2	FCU-A/ AREA-521			Variable refrigerant Flow System			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-564 L2	FCU-A/ AREA-564			Variable refrigerant Flow System			No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-476 L2	FCU-A/ AREA-476			Variable refrigerant Flow System			No. of Units 2
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	8900	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			**PASSES**

FCU-A/ AREA-516 L2	FCU-A/ AREA-516		Variable refrigerant Flow System			No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		PASSES
Heating System	Electric Furnace	8900	1.00	1.00			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			PASSES

FCU-A/ AREA-588 L2	FCU-A/ AREA-588		Variable refrigerant Flow System			No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		PASSES
Heating System	Electric Furnace	8900	1.00	1.00			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			PASSES

FCU-A/ AREA-437 L2	FCU-A/ AREA-437		Variable refrigerant Flow System			No. of Units 2

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	6900	13.00	13.00	8.00		PASSES
Heating System	Electric Furnace	8900	1.00	1.00			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	225	0.20	0.82			PASSES

FCU-B/ AREA-470 L2	FCU-B/ AREA-470		Variable refrigerant Flow System			No. of Units 1

Component	Category	Capacity	Eff Design	Eff Criteria	Integrated Eff-Design	Integrated Eff-Criteria	Comp-liance
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	11100	13.00	13.00	8.00		PASSES
Heating System	Electric Furnace	14000	1.00	1.00			PASSES
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	350	0.20	0.82			PASSES

FCU-B/ AREA-480 L2	FCU-B/ AREA-480		Variable refrigerant Flow System				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	11100	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	14000	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	350	0.20	0.82			**PASSES**

FCU-B/ AREA-395 L2	FCU-B/ AREA-395		Variable refrigerant Flow System				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	VRF Air Conditioners Air Cooled 0 to 65000 Btu/h Cooling Capacity	11100	13.00	13.00	8.00		**PASSES**
Heating System	Electric Furnace	14000	1.00	1.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	350	0.20	0.82			**PASSES**

MAU-1	MAU-1		Constant Volume Packaged System--902				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled 240000 - 760000 Btu/h Cooling Capacity	253660	14.30	9.80	13.00	13.00	**PASSES**
Heating System	Warm Air Gas Furnace >= 225000 Btu/h	240000	80.00	80.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	4120	0.80	0.82			**PASSES**

MAU-2	MAU-2		Constant Volume Packaged System--902				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled 135000 - 240000 Btu/h Cooling Capacity	198900	14.30	10.80	14.00	14.00	**PASSES**
Heating System	Warm Air Gas Furnace >= 225000 Btu/h	240000	80.00	80.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	3960	0.80	0.82			**PASSES**

MAU-3	MAU-3		Constant Volume Packaged System--902				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled 240000 - 760000 Btu/h Cooling Capacity	326970	14.30	9.80	14.00	13.00	**PASSES**
Heating System	Warm Air Gas Furnace >= 225000 Btu/h	240000	80.00	80.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	6130	0.80	0.82			**PASSES**

MAU-4	MAU-4		Constant Volume Packaged System--902				No. of Units 1
Component	**Category**	**Capacity**	**Eff Design**	**Eff Criteria**	**Integrated Eff-Design**	**Integrated Eff-Criteria**	**Comp-liance**
Cooling System	Air Conditioners Air Cooled 135000 - 240000 Btu/h Cooling Capacity	200530	14.30	10.80	14.00	14.00	**PASSES**
Heating System	Warm Air Gas Furnace >= 225000 Btu/h	240000	80.00	80.00			**PASSES**
Air Handling System -Supply	Air Handler (Supply) - Constant Volume	4210	0.80	0.82			**PASSES**

PASSES

Plant Compliance

Description	Installed No	Size	Design Eff	Min Eff	Design IPLV	Min IPLV	Category	Comp liance

None

Project: I22509
Title: THE GULF COAST REHABILITATION CENTER
Type: Healthcare-Clinic
(WEA File: FL_PANAMA_CITY_BAY_CO.tm3)

Water Heater Compliance

Description	Type	Category	Design Eff	Min Eff	Design Loss	Max Loss	Compliance
GWH-1	Gas Storage water heater	<= 75000 Btu/h; >= 20 - 55 Gal	0.94	0.55			**PASSES**
GWH-2	Gas Storage water heater	<= 75000 Btu/h; >= 20 - 55 Gal	0.94	0.55			**PASSES**

PASSES

Project: I22509
Title: THE GULF COAST REHABILITATION CENTER
Type: Healthcare-Clinic
(WEA File: FL_PANAMA_CITY_BAY_CO.tm3)

Piping System Compliance

Category	Pipe Dia [inches]	Is Runout?	Operating Temp [F]	Ins Cond [Btu-in/hr.SF.F]	Ins Thick [in]	Req Ins Thick [in]	Compliance
Heating System (Steam, Steam Condensate, & Hot Water)	0.50	False	108.00	0.28	0.50	0.50	**PASSES**

PASSES

Mandatory Requirements (as applicable)

Requirements compiled by US Department of Energy and Pacific Northwest National Laboratory. Adopted for FBC with permission. Not all may be applicable

Topic	Section	Component	Description	Yes	N/A	Exempt
1. To be checked by Designer or Engineer						
6037 Post Construction	C401.3	Envelope	A thermal envelope certificate will be supplied and completed by an approved third party.	☑	☐	☐
6031 Fenestration	C402.4.1	Envelope	The vertical fenestration area <= 30 percent of the gross above-grade wall area.	☑	☐	☐
6033 Fenestration	C402.4.1	Envelope	The skylight area <= 3 percent of the gross roof area.	☐	☑	☐
6036 Fenestration	C402.4.1.1	Envelope	Vertical Fenestration Area Allowance: A maximum of 40 percent of gross above-grade wall area is permitted to be vertical fenestration area provided in buildings not greater than two stories above grade, >= 50 percent of the conditioned floor area is within a daylight zone, in buildings three or more stories above grade, not less than 25 percent of the net floor area is within a daylight zone, daylight responsive controls are installed, and glazing assemblies within the scope of NFRC 200 have visible transmittance >= 1.1 times SHGC.	☑	☐	☐
6038 Fenestration	C402.4.1.2	Envelope	A maximum of 6 percent of roof area is permitted to be skylight area provided daylight responsive controls are installed in daylight zones under skylights.	☐	☑	☐
6039 Fenestration	C402.4.2	Envelope	In enclosed spaces > 2,500 ft2 directly under a roof with ceiling heights > 15 ft. and used as an office, lobby, atrium, concourse, corridor, storage, gymnasium/exercise center, convention center, automotive service, manufacturing, non-refrigerated warehouse, retail store, distribution/sorting area, transportation, or workshop, the following requirements apply: (a) the daylight zone under skylights is <= half the floor area; (b) the skylight area to daylight zone is >= 3 percent with a skylight VT >= 0.40; or a minimum skylight effective aperture >= 1 percent. []- Exception 1:C402.4.2: Buildings in climate zones 6 through 8. []- Exception 2:C402.4.2: Spaces where the proposed general lighting power densities < 0.5 W/ft2. []- Exception 3:C402.4.2: Areas with obstructions that block direct beam sunlight on >= 1/2 of the roof over the enclosed area for more than 1,500 daytime hours per year between 8 am and 4 pm. []- Exception 4:C402.4.2: Spaces where the daylight zone under rooftop monitors is > 50 percent of the enclosed space floor area. []- Exception 5:C402.4.2: Spaces where the total area net of daylight zones adjacent to vertical fenestration < 2,500 s.f. and where the lighting is controlled. []- Exception 6:C402.4.2: Requirement does not apply.	☐	☑	☐

6032 Fenestration	C402.4.3	Envelope	Vertical fenestration Maximum U-factor and SHGC value.	☑	☐	☐
6034 Fenestration	C402.4.3	Envelope	Skylight SHGC value.	☐	☑	☐
6040 Fenestration	C402.4.5	Envelope	U-factor of opaque swinging and nonswinging doors associated with the building thermal envelope meets requirements.	☑	☐	☐
6046 Post Construction	C402.5.11	Envelope	Operable openings > 40 ft2 will be interlocked with heating and cooling systems to setback setpoint temperatures within 10 minutes of opening. []- Exception 1:C402.5.11: Separately zoned areas. []- Exception 2:C402.5.11: Warehouses with overhead doors for occupancy. []- Exception 3:C402.5.11: Entrance doors located in exterior wall as part of a vestibule.	☐	☑	☐
6056 HVAC	C403.2.1	Mechanical	HVAC systems and equipment design loads calculated in accordance with ANSI/ASHRAE/ACCA Standard 183 or by an approved equivalent computational procedure []- Exception 1:C403.2.1: Mechanical systems are designed by a registered engineer	☑	☐	☐
6096 HVAC	C403.2.12.1	Mechanical	HVAC fan systems at design conditions do not exceed allowable fan system motor nameplate hp or fan system bhp. []- Exception 1:C403.2.12.1: Hospital and laboratory systems that utilize flow control devices on exhaust and/or return. []- Exception 2:C403.2.12.1: Individual exhaust fans with motor nameplate horsepower less than or equal 1 hp. []- Exception 3:C403.2.12.1: Requirement does not apply.	☑	☐	☐
6055 HVAC	C403.2.12.2	Mechanical	HVAC fan motors not oversized beyond allowable limits. []- Exception 1:C403.2.12.2: Fans equipped with electronic speed control devices []- Exception 2:C403.2.12.2: Fans with fan nameplate electrical input power < 0.89 kW []- Exception 3:C403.2.12.2: Fan system complying with Section C403.2.12.1 motor nameplate hp (Option 1). []- Exception 4:C403.2.12.2: Fans with motor nameplate horsepower < 1 hp (746 W). []- Exception 5:C403.2.12.2: Requirement does not apply.	☑	☐	☐

6141 SYSTEM_SPECIF	C403.2.12.3	Mechanical	Fans have a fan energy index (FEI) >= 1.00. Variable volume fans will have an FEI >= 0.95 at the design point of operation. []- Exception 1:C403.2.12.3: Single not embedded fans with motor nameplate horsepower of less than 1 hp (0.89 kW). []- Exception 2:C403.2.12.3: Embedded fans with motor nameplate horsepower exceeding 5 hp (4.1 kW). []- Exception 3:C403.2.12.3: Multiple fans in series or parallel have a combined motor nameplate horsepower of less or equal 5 hp and are operated functionally as a single fan. []- Exception 4:C403.2.12.3: Fans integral to equipment listed under Section C403.2.3. []- Exception 5:C403.2.12.3: Fans included in equipment having certified seal for air or energy performance of the equipment package. []- Exception 6:C403.2.12.3: Ceiling fans. []- Exception 7:C403.2.12.3: Fans for gases at temperatures above 425F. []- Exception 8:C403.2.12.3: Fans for operation in explosive atmospheres. []- Exception 9:C403.2.12.3: Reversible fans for tunnel ventilation. []- Exception 10:C403.2.12.3: Fans not covered by AMCA 208. []- Exception 11:C403.2.12.3: Fans intended to operate only during emergency conditions.	☑	☐	☐
6057 HVAC	C403.2.2	Mechanical	HVAC systems and equipment capacity does not exceed calculated loads. []- Exception 1:C403.2.2: Required standby equipment with proper controls per code. []- Exception 2:C403.2.2: Multiple units of the same type of equipment with sequencing controls. []- Exception 3:C403.2.2: Living spaces in commercial buildings shall be sized in accordance with Section R403.7.1.1 and its exceptions	☑	☐	☐

6087 HVAC	C403.2.7	Mechanical	Exhaust air energy recovery on systems meeting Table C403.7.4(1) and C403.7.4(2). []- Exception 1:C403.2.7: Where energy recovery systems are prohibited by the Florida Building Code, Mechanical []- Exception 2:C403.2.7: Laboratory fume hood systems []- Exception 3:C403.2.7: Systems serving spaces that are heated to less than 60°F (15.5°C) and are not cooled []- Exception 4:C403.2.7: Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy []- Exception 5:C403.2.7: Heating energy recovery in Climate Zones 1 and 2 []- Exception 6:C403.2.7: Cooling energy recovery in Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8 []- Exception 7:C403.2.7: Systems requiring dehumidification that employ energy recovery in series with the cooling coil []- Exception 8:C403.2.7: Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design outdoor air flow rate. []- Exception 9:C403.2.7: Systems expected to operate less than 20 hours per week at the outdoor air percentage covered by Table C403.2.7(1). []- Exception 10:C403.2.7: Systems exhausting toxic, flammable, paint or corrosive fumes or dust. []- Exception 11:C403.2.7: Commercial kitchen hoods used for collecting and removing grease vapors and smoke	☑	☐	☐
6047 HVAC	C403.3.2	Mechanical	Economizer operation will not increase heating energy use during normal operation. []- Exception 1:C403.3.2: Economizers on VAV systems.	☑	☐	☐

6093 HVAC	C403.3.3, C403.3.3.1, C403.3.3.2, C403.3.3.3, C403.3.3.4, C403.3.3.5	Mechanical	Air economizers provided where required, meet the requirements for design capacity, control signal, ventilation controls, high-limit shut-off, integrated economizer control, and provide a means to relieve excess outside air during operation. []- Exception 1:C403.3_C403.3.2: Buildings located in Climate Zones 1A and 1B. []- Exception 2:C403.3_C403.3.2: Individual DX fan cooling units have a capacity is < 54 KBtu/h (15.8 kW) or total chilled water system capacity < minimum specified in Table C403.3(1). []- Exception 3:C403.3_C403.3.2: Where more than 25 % of the air supplied to spaces that are designed to be humidified above 35°F (1.7°C) dewpoint temperature to satisfy process needs []- Exception 4:C403.3_C403.3.2: Systems that serve residential spaces where the system capacity is < 270 kBtu/h []- Exception 5:C403.3_C403.3.2: Systems expected to operate less than 20 hours per week []- Exception 6:C403.3_C403.3.2: System serves supermarket areas with open refrigerated casework. []- Exception 7:C403.3_C403.3.2: Where the minimum code required cooling efficiency of the HVAC unit rated with an IPLV, IEER or SEER is increased by at least 17 %. []- Exception 8:C403.3_C403.3.2: Chilled-water cooling systems that are passive (without a fan) capacity is < the minimum specified in Table C403.3(1). []- Exception 9:C403.3_C403.3.2: Systems that include a heat recovery system in accordance with Section C403.4.5 []- Exception 10:C403.3_C403.3.2: Economizers on VAV systems cause zone-level heating to increase due to a reduction in supply air temperature.	☑	☐	☐
6042 HVAC	C403.3.4, C403.3.4.1, C403.3.4.2, C403.3.1	Mechanical	Water economizers provided where required, meet the requirements for design capacity, maximum pressure drop and integrated economizer control. []- Exception 1:C403.2.12.5_C403.2.12.5.1_C403.2.12.5.2: Modulating fan control not required for chilled water and evaporative cooling units with fan motors of < 1 hp where the units are not used to provide ventilation air and the indoor fan cycles with the load. []- Exception 2:C403.2.12.5_C403.2.12.5.1_C403.2.12.5.2: Requirement does not apply.	☐	☑	☐
6053 HVAC	C403.4.2.3.1	Mechanical	Hydronic heat pump systems connected to a common water loop meet heat rejection and heat addition requirements. []- Exception 1:C403.4.2.3.1: A deadband of less than 20°F is allowed where a temperature optimization controller is used.	☐	☑	☐

6144 Mandatory Additior	C406.6	Project	Dedicate outdoor air system efficiency energy credit - Building equipped with independent ventilation system designed to provide 100-percent outdoor air to each individual occupied space, as specified by the IMC. The ventilation system is capable of total energy recovery and includes HVAC system controls that manage temperature resets at least 25 percent of delta design supply-air / room-air temp.	☑	☐	☐

2. To be checked by Plan Reviewer

6004 Plan Review	C103.2	Mechanical	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the mechanical and service water heating systems and document where exceptions to the standard are claimed. Load calculations per acceptable engineering standards and handbooks. Hot water system sized per manufacturer's sizing guide.	☐	☐	☐
6011 Plan Review	C103.2	Interior Lighting	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the interior lighting and electrical systems and equipment and document where exceptions to the standard are claimed. The information provided should include lighting controls per sections C405.2 and C405.3.	☐	☐	☐
6023 Plan Review	C103.2	Exterior Lighting	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the exterior lighting and electrical systems and equipment and document where exceptions to the standard are claimed. The information provided should include Exterior lighting power requirements (Mandatory) per section C405.4.	☐	☐	☐
6001 Plan Review	C103.2, C103.2.1	Envelope	Plans and/or specifications provide all information with which compliance can be determined for the building envelope and document where exceptions to the standard are claimed.	☐	☐	☐
6081 HVAC	C402.2.6	Mechanical	Thermally ineffective panel surfaces of sensible heating panels have insulation >= R-3.5. []- Exception 1:C402.2.6: Heated slabs on grade insulated in accordance with Section C402.2.5 []- Exception 2:C402.2.6: Requirement does not apply.	☐	☐	☐
6100 HVAC	C403.2.13	Mechanical	Systems that heat outside the building envelope are radiant heat systems controlled by an occupancy sensing device or timer switch. []- Exception 1:C403.12.1: Requirement does not apply.	☐	☐	☐
6068 HVAC	C403.2.4.1.3	Mechanical	Reset static pressure setpoint for DDC controlled VAV boxes reporting to central controller based on the zones requiring the most pressure. []- Exception 1:C403.4.1.3: Requirement does not apply.	☐	☐	☐
6107 HVAC	C403.2.4.2	Mechanical	Each zone equipped with setback controls using automatic time clock or programmable control system. []- Exception 1:C403.2.4.2: Zones operated continuously. []- Exception 2:C403.2.4.2: Zones have a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a readily accessible manual shutoff switch. []- Exception 3:C403.2.4.2: Requirement does not apply.	☐	☐	☐

6123 HVAC	C403.2.4.4	Mechanical	Zone isolation devices and controls installed where applicable. []- Exception 1:C403.2.4.4: Exhaust and outdoor air connections having fan systems 5000 cfm or smaller. []- Exception 2:C403.2.4.4: Exhaust airflow less than 10% of design. []- Exception 3:C403.2.4.4: Zones and systems intended to operate continuously or are inoperative when all other zones are inoperative. []- Exception 4:C403.2.4.4: Requirement does not apply.	☐ ☐ ☐
6124 HVAC	C403.2.4.7	Mechanical	Fault detection and diagnostics installed with air-cooled unitary DX units or VRF units having economizers. []- Exception 1:C403.2.4.7: Requirement does not apply.	☐ ☐ ☐
6125 HVAC	C403.2.5	Mechanical	Hot water boilers supplying heat via one- or two-pipe systems include outdoor setback control. []- Exception 1:C403.2.5: Requirement does not apply.	☐ ☐ ☐
6089 HVAC	C403.2.6	Mechanical	Natural or mechanical ventilation is provided in accordance with International Mechanical Code Chapter 4. Mechanical ventilation has capability to reduce outdoor air supply to minimum per IMC Chapter 4. []- Exception 1:C403.2.2: Requirement does not apply.	☐ ☐ ☐
6090 HVAC	C403.2.6.1	Mechanical	Demand control ventilation provided for spaces >500 ft2 and >=25 people/1000 ft2 occupant density and served by systems with air side economizer, auto modulating outside air damper control, or design airflow >3,000 cfm. []- Exception 1:C403.2.6.1: Systems with energy recovery complying with Section C403.2.7. []- Exception 2:C403.2.6.1: Multiple-zone systems without DDC. []- Exception 3:C403.2.6.1: Multiple-zone systems with design outdoor air of less than 1200 cfm. []- Exception 4:C403.2.6.1: Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is < 1,200 cfm []- Exception 5:C403.2.6.1: Ventilation provided for process loads only []- Exception 6:C403.2.6.1: Requirement does not apply.	☐ ☐ ☐
6098 HVAC	C403.4.2	Mechanical	The heating of fluids in hydronic systems that have been previously mechanically cooled, and the cooling of fluids that have been previously mechanically heated are limited in accordance with Sections C403.4.2.1-C403.4.2.3. Single boiler systems >500 kBtu/h have multistaged or modulating burner. []- Exception 1:C403.4.2: Requirement does not apply.	☐ ☐ ☐

6142 HVAC	C403.4.2.3.2	Mechanical	Closed-circuit cooling tower within heat pump loop have either automatic bypass valve or lower leakage positive closure dampers. Open-circuit tower within heat pump loop have automatic valve to bypass all heat pump water flow around the tower. Open- or closed-circuit cooling towers used in conjunction with a separate heat exchanger have heat loss by shutting down the circulation pump on the cooling tower loop. Open- or closed circuit cooling towers have a separate heat exchanger to isolate the cooling tower from the heat pump loop, and heat loss is controlled by shutting down the circulation pump on the cooling tower loop. []- Exception 1:C403.4.2.3.2: Heat pump system must reject heat throughout the year. []- Exception 2:C403.4.2.3.2: Requirement does not apply.	☐ ☐ ☐
6116 HVAC	C403.4.2.5	Mechanical	System turndown requirement met through multiple single-input boilers, one or more modulating boilers, or a combination of single-input and modulating boilers. Boiler shall comply with the turndown ratio specified in Table C403.4.2.5.	☐ ☐ ☐
6071 HVAC	C403.4.2.6	Mechanical	Chilled water plants with multiple chillers have capability to reduce flow automatically through the chiller plant when a chiller is shut down. Boiler plants with multiple boilers have the capability to reduce flow automatically through the boiler plant when a boiler is shut down.	☐ ☐ ☐
6099 HVAC	C403.4.3.1	Mechanical	Fan systems with total system motor capacity >=5 hp associated with heat rejection equipment configured to automatically modulate the fan speed to control the leaving fluid temperature or condensing temp/pressure of heat rejection device. []- Exception 1:C403.4.3.1: Fans serve multiple refrigerant or fluid cooling circuits. []- Exception 2:C403.4.3.1: Condenser fans serve flooded condensers. []- Exception 3:C403.4.3.1: Requirement does not apply.	☐ ☐ ☐
6120 HVAC	C403.4.3.4	Mechanical	Open-circuit cooling towers having water cooled chiller systems and multiple or variable speed condenser pumps, are designed so that tower cells can run in parallel with larger of flow criteria. []- Exception 1:C403.4.3.4: Requirement does not apply.	☐ ☐ ☐

6103 HVAC	C403.6.1	Mechanical	Hydronic and multizone HVAC system controls are VAV fans driven by mechanical or electrical variable speed drive per Table C403.4.1.1. []- Exception 1:C403.4.4: Zones or supply air systems where >= 75 % of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered or site-solar energy source []- Exception 2:C403.4.4: Zones where special humidity levels are required to satisfy process needs []- Exception 3:C403.4.4: Zones with a peak supply air of <= 300 cfm (142 L/s) and where the flow rate is < 10 % of the total fan system supply airflow rate. []- Exception 4:C403.4.4: Zones where the volume of air to be reheated, recooled or mixed is <= the minimum ventilation requirements of Chapter 4 of the Florida Building Code, Mechanical []- Exception 5:C403.4.4: Zones or supply air systems with thermostatic and humidistatic controls capable of preventing reheating, recooling, mixing or simultaneous supply of air that has been previously cooled []- Exception 6:C403.4.4: Requirement does not apply.	☐	☐	☐
6122 HVAC	C404.2.1	Mechanical	Gas-fired water-heating equipment installed in new buildings: where a singular piece of water-heating equipment >= 1,000 kBtu/h serves the entire building, thermal efficiency <= 92 Et. Where multiple pieces of water-heating equipment serve the building with combined rating <= 1,000 kBtu/h, the combined input-capacity-weighted-average thermal efficiency <= 90 Et. Exclude input rating of equipment in individual dwelling units and equipment <= 100 kBtu/h []- Exception 1:C404.2.1: 25 percent or more of the annual service water heating requirement is provided by on-site renewable energy or site-recovered energy. []- Exception 2:C404.2.1: Water heaters installed in individual dwelling units shall not be required to be included in the total input rating of service waterheating equipment []- Exception 3:C404.2.1: Water heaters with an input rating of <= 100,000 Btu/h (29.3 kW) not required to be included in the total input rating of service water-heating equipment []- Exception 4:C404.2.1: Requirement does not apply.	☐	☐	☐
6114 HVAC	C404.4	Mechanical	All piping insulated in accordance with section details and Table C403.12.3. []- Exception 1:C404.4: Requirement does not apply.	☐	☐	☐
6019 HVAC	C404.5, C404.5.1, C404.5.2	Mechanical	Heated water supply piping conforms to pipe length and volume requirements. Refer to section details. []- Exception 1:C404.5_C404.5.1_C404.5.2: Requirement does not apply.	☐	☐	☐
6022 HVAC	C404.6.3	Mechanical	Pumps that circulate water between a heater and storage tank have controls that limit operation from startup to <= 5 minutes after end of heating cycle. []- Exception 1:C404.6.3: Requirement does not apply.	☐	☐	☐

6026 HVAC	C404.7	Mechanical	Demand recirculation water systems have controls that start the pump upon receiving a signal from the action of a user of a fixture or appliance and limits the temperature of the water entering the cold-water piping to 104°F. []- Exception 1:C404.7: Requirement does not apply.	☐ ☐ ☐
6048 Plan Review	C405.5.2	Project	Group R-2 dwelling units have separate electrical meters. []- Exception 1:C405.5.2: Requirement does not apply.	☐ ☐ ☐
6030 Plan Review	C406	Project	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the additional energy efficiency package options.	☐ ☐ ☐
6084 HVAC	C408.2.2.2	Mechanical	HVAC hydronic heating and cooling coils have means to balance and have pressure test connections. []- Exception 1:C408.2.2.2: Pumps with pump motors of 5 hp (3.7 kW) or less. []- Exception 2:C408.2.2.2: Where throttling results in no greater than 5 percent of the nameplate horsepower draw above that required if the impeller were trimmed.	☐ ☐ ☐

3. To be checked by Inspector

6016 Insulation	C104	Envelope	Installed above-grade wall insulation type and R-value consistent with insulation specifications reported in plans.	☐ ☐ ☐
6006 Insulation	C104, C303.1.1	Envelope	Installed roof insulation type and R-value consistent with insulation specifications reported in plans. For some ceiling systems, verification may need to occur during Framing Inspection.	☐ ☐ ☐
6008 Insulation	C104.2.1	Envelope	Installed slab-on-grade insulation type and R-value consistent with insulation specifications reported in plans.	☐ ☐ ☐
6007 Insulation	C303.1, C303.1.1	Envelope	Roof insulation installed per manufacturer's instructions and is labeled with R-value or insulation certificate providing R-value and other relevant data. Blown or poured loose-fill insulation is installed only where the roof slope is > 3 in 12.	☐ ☐ ☐
6035 Fenestration	C303.1.3	Envelope	Fenestration products rated in accordance with NFRC certified and as to performance labels or certificates provided. []- Exception 1:C303.1.3: Default values are used.	☐ ☐ ☐
6020 Insulation	C303.2	Envelope	Above-grade wall insulation installed per manufacturer's instructions.	☐ ☐ ☐
6005 Insulation	C303.2, C303.2.1	Envelope	Below-grade wall insulation installed per manufacturer's instructions.	☐ ☐ ☐
6013 Insulation	C303.2, C303.2.1	Envelope	Slab edge insulation installed per manufacturer's instructions and the Florida Building Code, Building.	☐ ☐ ☐

6027 Insulation	C303.2, C402.2.4	Envelope	Floor insulation installed per manufacturer's instructions. Cavity or structural slab insulation installed in permanent contact with underside of decking or structural slabs. []- Exception 1:C303.2_C402.2.4: All perimeter framing fully insulated at metal or wood framed prescriptive levels. []- Exception 2:C303.2_C402.2.4: Concrete floor slab insulation turns up and contacts underside of floor under wall assembly. []- Exception 3:C303.2_C402.2.4: Requirement does not apply.	☐ ☐ ☐
6015 Insulation	C303.2.1	Envelope	Exterior insulation protected against damage, sunlight, moisture, wind, landscaping and equipment maintenance activities.	☐ ☐ ☐
6002 Insulation	C402.1.3	Envelope	Installed below-grade wall insulation type and R-value consistent with insulation specifications reported in plans.	☐ ☐ ☐
6061 Insulation	C402.1.3	Envelope	Non-swinging opaque doors have R-4.75 insulation. []- Exception 1:C402.1.3: Requirement does not apply.	☐ ☐ ☐
6012 Insulation	C402.2.2	Envelope	Skylight curbs are insulated to the level of roofs with insulation above deck or R-5, whichever is less. []- Exception 1:C402.2.1.5: Unit skylight curbs included as a component of a skylight listed and labeled per NFRC 100. []- Exception 2:C402.2.1.5: Requirement does not apply.	☐ ☐ ☐
6064 Insulation	C402.2.2	Envelope	Roof assembly meets minimal thermal resistance installed between roof framing or in a continuous fashion on the roof assembly as stipulated in Table C402.1.3. Requirements for above deck insulation, minimum thickness, suspended ceilings, staggered joints and skylight curbs will be met. []- Exception 1:C402.2.1: Requirement does not apply.	☐ ☐ ☐
6024 Insulation	C402.2.3	Envelope	Installed floor insulation type and R-value consistent with insulation specifications reported in plans.	☐ ☐ ☐
6021 Insulation	C402.2.5, C402.2.5.1	Envelope	Slab edge insulation depth/length. Slab insulation extending away from building is covered by pavement or >= 10 inches of soil. []- Exception 1:C402.2.5_C402.2.5.1: Requirement does not apply.	☐ ☐ ☐
6051 Insulation	C402.2.6	Envelope	Radiant panels and associated components, designed for heat transfer from the panel surfaces to the occupants or indoor space are insulated with a minimum of R-3.5. []- Exception 1:C402.2.6: Heated slab-on-grade. []- Exception 2:C402.2.6: Requirement does not apply.	☐ ☐ ☐

6014 Insulation	C402.3	Envelope	High-albedo roofs satisfy one of the following: 3-year-aged solar reflectance >= 0.55 (0.63 for Climate Zone 1A) and thermal emittance >= 0.75 or 3-year-aged solar reflectance index >= 64.0 (75 for Climate Zone 1A). []- Exception 1:C402.3: Roof Over Conditioned Space With No Cooling. []- Exception 2:C402.3: Ballasted Roof. []- Exception 3:C402.3: Vegetated Roof (75% coverage). []- Exception 4:C402.3: Shaded or Covered Roof (75% coverage). []- Exception 5:C402.3: Asphaltic Membrane Roof. []- Exception 6:C402.3: Steep Sloped Roof.	☐	☐	☐
6028 Fenestration	C402.4.3	Envelope	Installed skylight U-factor and SHGC consistent with label specifications and as reported in plans.	☐	☐	☐
6025 Fenestration	C402.4.3, C402.4.3.4	Envelope	Installed vertical fenestration U-factor and SHGC consistent with label specifications and as reported in plans.	☐	☐	☐
6043 Air Leakage	C402.5	Envelope	Building envelope contains a continuous air barrier that has been tested and deemed to limit air leakage <= 0.40 cfm/ft2 of the building thermal envelope area at a pressure differential of 0.3 inch water gauge (75 Pa).	☐	☐	☐
6044 Air Leakage	C402.5.1	Envelope	The building envelope contains a continuous air barrier that is sealed in an approved manner and either constructed or tested in an approved manner. Air barrier penetrations are sealed in an approved manner. []- Exception 1:C402.5.1: Requirement does not apply.	☐	☐	☐
6003 Air Leakage	C402.5.1.1	Envelope	All sources of air leakage in the building thermal envelope are sealed, caulked, gasketed, weather stripped or wrapped with moisture vapor-permeable wrapping material to minimize air leakage.	☐	☐	☐
6062 Air Leakage	C402.5.1.2.1	Envelope	The building envelope contains a continuous air barrier that is sealed in an approved manner and material permeability <= 0.004 dfm/ft2. Air barrier penetrations are sealed in an approved manner. []- Exception 1:C402.5.1.2.1: Requirement does not apply.	☐	☐	☐
6065 Air Leakage	C402.5.1.2.2	Envelope	The building envelope contains a continuous air barrier that is sealed in an approved manner and average assembly air leakage <= 0.04 cfm/ft2. Air barrier penetrations are sealed in an approved manner. []- Exception 1:C402.5.1.2.2: Requirement does not apply.	☐	☐	☐
6052 Air Leakage	C402.5.4	Envelope	Factory-built fenestration and doors are labeled as meeting air leakage requirements. []- Exception 1:C402.5.4: Field fabricated fenestration assemblies. []- Exception 2:C402.5.4: Fenestration in buildings that comply with air leakage requirements with a whole building air leakage test. []- Exception 3:C402.5.4: Doors that comply with special International Building Code requirements.	☐	☐	☐
6009 Air Leakage	C402.5.5, C402.5.11, 403.6	Envelope	Stair and elevator shaft vents have motorized dampers that automatically close. Reference section C403.6 for operational details.	☐	☐	☐

6049 Air Leakage	C402.5.6	Envelope	Weatherseals installed on all loading dock cargo door openings and provide direct contact along the top and sides of vehicles parked in the doorway. []- Exception 1:C402.5.6: Requirement does not apply.	☐ ☐ ☐
6050 Air Leakage	C402.5.7	Envelope	Vestibules are installed on all building entrances. Doors have self-closing devices. []- Exception 1:C402.5.7: Building entrances with revolving doors. []- Exception 2:C402.5.7: Doors not intended to be used as a building entrance. []- Exception 3:C402.5.7: Doors opening directly from a sleeping unit or dwelling unit. []- Exception 4:C402.5.7: Doors that open directly from a space <=3000 ft2. []- Exception 5:C402.5.7: Doors with air curtain. []- Exception 6:C402.5.7: Existing door is being replaced and existing vestibules not removed. []- Exception 7:C402.5.7: Requirement does not apply.	☐ ☐ ☐
6045 Air Leakage	C402.5.8	Envelope	Recessed luminaires in thermal envelope to limit infiltration and be IC rated and labeled. Seal between interior finish and luminaire housing. []- Exception 1:C402.5.10: Requirement does not apply.	☐ ☐ ☐
6086 HVAC	C403.2	Mechanical	HVAC equipment efficiency verified.	☐ ☐ ☐
6092 HVAC	C403.2.10	Mechanical	HVAC piping insulation insulated in accordance with Table C403.2.10. Insulation exposed to weather is protected from damage and is provided with shielding from solar radiation. []- Exception 1:C403.2.10: Factory-installed piping within HVAC equipment []- Exception 2:C403.2.10: Factory-installed piping within room fan-coils and unit ventilators tested under AHRI 440. []- Exception 3:C403.2.10: Piping that conveys fluids that have a design operating temperature range between 60 and 105°F. []- Exception 4:C403.2.10: Fluid not heated or cooled. []- Exception 5:C403.2.10: Strainers and valves associated with 1 inch or smaller piping. []- Exception 6:C403.2.10: Underground piping with fluids no hotter than 60ºF. []- Exception 7:C403.2.10: Piping design for radiant heating systems []- Exception 8:C403.2.10: Requirement does not apply.	☐ ☐ ☐

6171 HVAC	C403.2.12.4	Mechanical	Motors for fans that are not less than 1/12 hp and less than 1 hp are electronically commutated motors or have a minimum motor efficiency of 70 percent. These motors have the means to adjust motor speed for either balancing or remote control. []- Exception 1:C403.2.12.4: Motors in the airstream within fan coils and terminal units only provide heating to the space served. []- Exception 2:C403.2.12.4: Motors in space-conditioning equipment that comply with Section C403.2.3 or C403.2.12. []- Exception 3:C403.2.12.4: Motors that comply with Section C405.7. []- Exception 4:C403.2.12.4: Requirement does not apply.	☐ ☐ ☐
6173 HVAC	C403.2.12.5.1	Mechanical	Each DX cooling system >= 65 kBtu and chiller water/evaporative cooling system with fans >= 1/4 hp are designed to vary the indoor fan airflow as a function of load and comply with detailed requirements of this section. []- Exception 1:C403.2.12.5.1: Modulating fan control is not required for chilled water and evaporative cooling units with fan motors of less than 1 hp where the units are not used to provide ventilation air and the indoor fan cycles with the load. []- Exception 2:C403.2.12.5.1: Where the volume of outdoor air required to comply with the ventilation requirements of the IMC at low speed exceeds the air that would be delivered per Section C403.2.12.5 []- Exception 3:C403.2.12.5.1: Requirement does not apply.	☐ ☐ ☐
6097 HVAC	C403.2.12.5.2	Mechanical	VAV fans have static pressure sensors located so controller setpoint <=1.2 w.c.. []- Exception 1:C403.2.12.5.2: Requirement does not apply.	☐ ☐ ☐
6168 HVAC	C403.2.12.5.2	Mechanical	Static pressure sensors used to control VAV fans located such that the controller setpoint is <= 1.2 inches w.c.. Where this results in one or more sensors being located downstream of major duct splits, not less than one sensor located on each major branch. []- Exception 1:C403.2.12.5.2: Requirement does not apply.	☐ ☐ ☐
6167 HVAC	C403.2.12.5.3	Mechanical	Systems with DDC of individual zones reporting to the central control panel configured to reset the static pressure setpoint based on zone requiring the most pressure. The DDC is capable of monitoring zone damper positions or have an alternative method of indicating the need for static pressure. See section for details. []- Exception 1:C403.2.12.5.3: Requirement does not apply.	☐ ☐ ☐
6178 HVAC	C403.2.12.6	Mechanical	Large diameter fans where installed shall be tested and labeled in accordance with AMCA 230. []- Exception 1:C403.2.12.6: Requirement does not apply.	☐ ☐ ☐

6155 HVAC	C403.2.14, C403.2.14.1, C403.2.14.2	Mechanical	Refrigeration equipment performance shall be determined in accordance with sections C403.2.14.1 and C403.2.14.2 for commercial refrigerators, freezers, refrigerator-freezers, walk-in coolers, walk-in freezers and refrigeration equipment. []- Exception 1:C403.5: Systems have working fluid in the refrigeration cycle that goes through both subcritical and supercritical states (transcritical). []- Exception 2:C403.5: Systems use ammonia refrigerant. []- Exception 3:C403.5: Requirement does not apply.	☐	☐	☐
6102 HVAC	C403.2.3	Mechanical	PTAC and PTHP with sleeves 16 in. by 42 in. labeled for replacement only as per Footnote b to Tables C403.2.3(1) and C403.2.3(2). []- Exception 1:C403.3: Requirement does not apply.	☐	☐	☐
6058 HVAC	C403.2.4.1	Mechanical	Heating and cooling to each zone is controlled by a thermostat control. Minimum one humidity control device per installed humidification/dehumidification system. []- Exception 1:C403.2.4.1: TRUE	☐	☐	☐
6059 HVAC	C403.2.4.1.1	Mechanical	Heat pump controls prevent supplemental electric resistance heat from coming on when not needed. []- Exception 1:C403.2.4.1.1: Requirement does not apply.	☐	☐	☐
6060 HVAC	C403.2.4.1.2	Mechanical	Thermostatic controls have a 5 °F deadband. []- Exception 1:C403.2.4.1.2: Manual changeover thermostats. []- Exception 2:C403.2.4.1.2: Precision indoor temperature control required.	☐	☐	☐
6085 HVAC	C403.2.4.1.3	Mechanical	Temperature controls have setpoint overlap restrictions. []- Exception 1:C403.2.4.1.3: Requirement does not apply.	☐	☐	☐
6108 HVAC	C403.2.4.2.1, C403.2.4.2.2	Mechanical	Automatic Controls: Setback to 55°F (heat) and 85°F (cool); 7-day clock, 2-hour occupant override, 10-hour backup []- Exception 1:C403.2.4.2.1_C403.2.4.2.2: Requirement does not apply.	☐	☐	☐
6110 HVAC	C403.2.4.2.3	Mechanical	Systems include optimum start controls. []- Exception 1:C403.2.4.2.3: Requirement does not apply.	☐	☐	☐

6088 Air Leakage	C403.2.4.3	Mechanical	Outdoor air and exhaust systems have motorized dampers that automatically shut when not in use and meet maximum leakage rates. Check gravity dampers where allowed. Reference section language for operational details. []- Exception 1:C403.2.4.3: Gravity dampers acceptable in buildings less than 3 stories. []- Exception 2:C403.2.4.3: Gravity dampers acceptable for exhaust and relief dampers in climate zones 0, 1, 2, or 3. []- Exception 3:C403.2.4.3: Gravity dampers acceptable in systems with outside or exhaust air flow rates less than or equal to 300 cfm. []- Exception 4:C403.2.4.3: Dampers no larger than 24 inches in any dimension are to have a leakage rate of 40 cfm/ft2 at 1.0 inch water gauge when tested with AMCA 500D. []- Exception 5:C403.2.4.3: Requirement does not apply.	☐ ☐ ☐
6029 HVAC	C403.2.4.5	Mechanical	Snow/ice melting system and freeze protection systems have sensors and controls configured to limit service for pavement temperature above 50°F and outdoor temperature above 40°F. []- Exception 1:C403.12.2_C403.12.3: Requirement does not apply.	☐ ☐ ☐
6170 HVAC	C403.2.4.8	Mechanical	HVAC systems serving guestrooms in Group R-1 buildings with < 50 guestrooms: Each guestroom is provided with controls that automatically manage temperature setpoint and ventilation (see sections C403.2.4.8.1 and C403.2.4.8.2). []- Exception 1:C403.2.4.8: Requirement does not apply.	☐ ☐ ☐
6128 HVAC	C403.2.6.2	Mechanical	Enclosed parking garage ventilation has automatic contaminant detection and capacity to stage or modulate fans to 50% or less of design capacity. []- Exception 1:C403.2.6.2: Garages with no mechanical cooling or heating that have exhaust capacity < 8,000 cfm. []- Exception 2:C403.2.6.2: Garages with no mechanical cooling or heating that have a ratio of garage area ventilation to ventilation system motor nameplate hp exceed 1125 cfm/hp. []- Exception 3:C403.2.6.2: Requirement does not apply.	☐ ☐ ☐
6169 HVAC	C403.2.7	Mechanical	Units that provide ventilation air to multiple zones and operate in combination with zone heating and cooling systems do not use heating or heat recovery to warm supply air to a temperature greater than 60°F when representative building loads or outdoor air temperatures indicate that the majority of zones require cooling. []- Exception 1:C403.7.3: Requirement does not apply.	☐ ☐ ☐
6129 HVAC	C403.2.8	Mechanical	Kitchen exhaust systems comply with replacement air and conditioned supply air limitations, and satisfy hood rating requirements and maximum exhaust rate criteria. []- Exception 1:C403.2.8: Requirement does not apply.	☐ ☐ ☐

6091 HVAC	C403.2.9	Mechanical	HVAC ducts and plenums insulated in accordance with C403.2.9.1 and constructed in accordance with C403.2.9.2, Sealed in accordance with C403.2.9.3. verification may need to occur during Foundation Inspection. []- Exception 1:C403.2.9_C403.2.9.1: Factory-installed as part of HVAC equipment. []- Exception 2:C403.2.9_C403.2.9.1: Where the design temperature difference between the inside and outside of the duct or plenum is less than 15ºF. []- Exception 3:C403.2.9_C403.2.9.1: Runouts less than 10 feet (3048 mm) in length to air terminals or air outlets, the rated R-value of insulation need not exceed R-5. []- Exception 4:C403.2.9_C403.2.9.1: Backs of air outlets and outlet plenums exposed to unconditioned spaces need not exceed R-2. []- Exception 5:C403.2.9_C403.2.9.1: Return air ducts meeting all the requirements for building cavities that will be used as return air plenums []- Exception 6:C403.2.9_C403.2.9.1: Requirement does not apply.	☐ ☐ ☐
6174 SYSTEM_SPECIF	C403.3.2	Mechanical	Equipment minimum efficiency:	☐ ☐ ☐
6175 SYSTEM_SPECIF	C403.3.2	Mechanical	Equipment minimum efficiency:	☐ ☐ ☐
6157 HVAC	C403.3.3.3	Mechanical	Air economizers automatically reduce outdoor air intake to the design minimum outdoor air quantity when outdoor air intake will not reduce cooling energy usage. See Table C403.3.3.3 for applicable device types and climate zones. []- Exception 1:C403.3.3.3: Requirement does not apply.	☐ ☐ ☐
6158 HVAC	C403.3.3.4	Mechanical	System capable of relieving excess outdoor air during air economizer operation to prevent over pressurizing the building. The relief air outlet located to avoid recirculation into the building. []- Exception 1:C403.3.3.4: Requirement does not apply.	☐ ☐ ☐
6159 HVAC	C403.3.3.5	Mechanical	Return, exhaust/relief and outdoor air dampers used in economizers have motorized dampers that automatically shut when not in use and meet maximum leakage rates. Reference section C403.2.4.3 for details. []- Exception 1:C403.3.3.5: Requirement does not apply.	☐ ☐ ☐
6094 HVAC	C403.4.1.4	Mechanical	Heating for vestibules and air curtains with integral heating include automatic controls that shut off the heating system when outdoor air temperatures < 45F. Vestibule heating and cooling systems controlled by a thermostat in the vestibule with heating setpoint <= 60F and cooling setpoint <= 80F. []- Exception 1:C402.5.7: Buildings in Climate Zones 1 and 2. []- Exception 2:C402.5.7: Requirement does not apply.	☐ ☐ ☐
6082 HVAC	C403.4.2.1	Mechanical	Three-pipe hydronic systems using a common return for hot and chilled water are not used.	☐ ☐ ☐

6095 HVAC	C403.4.2.2	Mechanical	Two-pipe hydronic systems using a common distribution system have controls to allow a deadband >=15 °F, allow operation in one mode for at least 4 hrs before changeover, and have rest controls to limit heating and cooling supply temperature to <=30 °F.	☐ ☐ ☐
6072 HVAC	C403.4.2.3.3	Mechanical	Two-position automatic valve interlocked to shut off water flow when hydronic heat pump with pumping system > 10 hp is off.	☐ ☐ ☐
6172 HVAC	C403.4.3.2	Mechanical	Multiple-cell heat rejection equipment with variable speed fan drives are controlled to operate the maximum number of fans allowed and so that all fans operate at the same fan speed required for the instantaneous cooling duty. The minimum fan speed will be the minimum allowable speed of the fan drive system in accordance with the manufacturer's recommendations. []- Exception 1:C403.4.3.2: Requirement does not apply.	☐ ☐ ☐
6118 SYSTEM_SPECIFI	C403.4.3.3	Mechanical	Centrifugal fan open-circuit cooling towers having combined rated capacity >= 1100 gpm meets minimum efficiency requirement: >=40.2 gpm/hp. []- Exception 1:C403.4.3.3: Centrifugal open-circuit cooling towers with external sound attenuation or that have ducted inlet or discharge. []- Exception 2:C403.4.3.3: Requirement does not apply.	☐ ☐ ☐
6160 HVAC	C403.4.4	Mechanical	Supply air systems serving multiple zones have VAV systems with controls configured to reduce the volume of air that is reheated, recooled or mixed in each zone. See section for details. []- Exception 1:C403.6.1: Zones or systems with at least 75% of energy used for heating or warming air Systems that prevent reconditioning, mixing or simultaneous supply of air that has previously been mechanically cooled (including via economizers) or heated. []- Exception 2:C403.6.1: Requirement does not apply.	☐ ☐ ☐
6161 HVAC	C403.4.4.1	Mechanical	Single-duct VAV systems use terminal devices configured to reduce the supply of primary supply air before reheating or recooling takes place. []- Exception 1:C403.4.4.1: Requirement does not apply.	☐ ☐ ☐
6162 HVAC	C403.4.4.2	Mechanical	Systems that have 1 warm air duct and 1 cool air duct use terminal devices configured to reduce the flow from one duct to a minimum before mixing of air from the other duct takes place. []- Exception 1:C403.4.4.1: Requirement does not apply.	☐ ☐ ☐
6163 HVAC	C403.4.4.3	Mechanical	Individual dual-duct or mixing heating and cooling systems with a single fan and with total capacities > 90,000 Btu/h not equipped with air economizers. []- Exception 1:C403.4.4.1: Requirement does not apply.	☐ ☐ ☐

6164 HVAC	C403.4.4.5	Mechanical	Multiple zone HVAC systems have supply air temperature reset controls based on building loads or outside temperatures. []- Exception 1:C403.4.4.5: Systems that prevent re-heating, re-cooling, or mixing of heated and cooled supply air. []- Exception 2:C403.4.4.5: Systems in which at least 75% of the energy for reheating is from site recovered or site solar energy resources. []- Exception 3:C403.4.4.5: Zones in climate zones 1A and 3A with less than 300 cfm design outside air. []- Exception 4:C403.4.4.5: Zones in climate zone 2A with with less than 10,000 cfm of design outside air. []- Exception 5:C403.4.4.5: Zones in climate zones 1A, 2A, and 3A with >= 80% outside air and employing exhaust air energy recovery. []- Exception 6:C403.4.4.5: Requirement does not apply.	☐	☐	☐
6165 HVAC	C403.4.4.6	Mechanical	Multiple zone VAV systems with DDC of individual zone boxes have static pressure setpoint reset controls. []- Exception 1:C403.4.4.6: VAV systems that recirculate air from other zones without directly mixing it with outdoor air or dual-duct dual-fan VAV systems, or VAV systems with fan-powered terminal units. []- Exception 2:C403.4.4.6: Systems where the design exhaust airflow is more than 70% of design outdoor air intake flow. []- Exception 3:C403.4.4.6: Requirement does not apply.	☐	☐	☐
6166 HVAC	C403.4.4.7	Mechanical	Parallel-flow fan-powered VAV air terminals have automatic controls configured to 1) turn off the terminal fan except when space heating is required or where required for ventilation, 2) turn on the terminal fan as the first stage of heating before the heating coil is activated, and 3) during heating for warmup or setback temperature control, either operate the terminal fan and heating coil without primary air or, reverse the terminal damper logic and provide heating from the central air handler by primary air. []- Exception 1:C403.4.4.7: Requirement does not apply.	☐	☐	☐
6076 HVAC	C403.4.5	Mechanical	Condenser heat recovery system that can heat water to 85 ºF or provide 60% of peak heat rejection is installed for preheating of service hot water. []- Exception 1:C403.4.5: Facility operates < 24/7. []- Exception 2:C403.4.5: Total installed heat capacity of water cooled systems <= 6 MMBtu/h of heat rejection. []- Exception 3:C403.4.5: Design SWH load <= 1 MMBtu/h. []- Exception 4:C403.4.5: Facilities using condenser heat recovery for space heating with heat recovery exceeding 30% of the peak water-cooled condenser load. []- Exception 5:C403.4.5: Facilities providing 60% of their service water heating from site-solar, site-recovered, or other energy sources.	☐	☐	☐

6080 HVAC	C403.4.6	Mechanical	Hot gas bypass limited to: <=240 kBtu/h – 50%; <240 kBtu/h – 25%	☐	☐	☐
6101 HVAC	C404.2	Mechanical	Service water heating equipment meets efficiency requirements.	☐	☐	☐
6113 HVAC	C404.3	Mechanical	Heat traps installed on supply and discharge piping of non-circulating systems. []- Exception 1:C404.3: Tank inlets/outlets associated with solar water heating systems. []- Exception 2:C404.3: Requirement does not apply.	☐	☐	☐
6115 HVAC	C404.6.1	Mechanical	Controls are installed that limit the operation of a recirculation pump installed to maintain temperature of a storage tank. System return pipe is a dedicated return pipe or a cold water supply pipe. []- Exception 1:C404.6.1: Requirement does not apply.	☐	☐	☐
6010 HVAC	C404.6.1, C404.6.2	Mechanical	Automatic time switches installed to automatically switch off the recirculating hot-water system or heat trace.	☐	☐	☐
6126 HVAC	C404.9.1	Mechanical	Pool heaters are equipped with on/off switch and no continuously burning pilot light.	☐	☐	☐
6127 HVAC	C404.9.2	Mechanical	Time switches are installed on all pool heaters and pumps. []- Exception 1:C404.9.2: Where 24-hr pump operation required for public health. []- Exception 2:C404.9.2: Solar and waste heat recovery pool heating pumps. []- Exception 3:C404.9.2: Requirement does not apply.	☐	☐	☐
6130 HVAC	C404.9.3	Mechanical	Vapor retardant pool covers are provided for heated pools and permanently installed spas. []- Exception 1:C404.9.3: Pools deriving > 75% of the energy for heating (of not fewer than 3 months) from heat pump or site-recovered energy. []- Exception 2:C404.9.3: Requirement does not apply.	☐	☐	☐

6054 Controls	C405.2.1, C405.2.1.1	Interior Lighting	Occupancy sensors installed in classrooms/lecture/training rooms, conference/meeting/multipurpose rooms, copy/print rooms, lounges/breakrooms, enclosed offices, open plan office areas, restrooms, storage rooms, locker rooms, corridors, warehouse storage areas, and other spaces <= 300 sqft that are enclosed by floor-to-ceiling height partitions. Reference section language C405.2.1.2 for control function in warehouses and section C405.2.1.3 for open plan office spaces. []- Exception 1:C405.2.1_C405.2.1.1: Automatic-on controls are allowed in corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on controls could impact safety or security. []- Exception 2:C405.2.1_C405.2.1.1: Areas such as security or emergency areas that need continuous lighting. []- Exception 3:C405.2.1_C405.2.1.1: Emergency egress lighting. []- Exception 4:C405.2.1_C405.2.1.1: Lighting that is related to means of egress in stairways, ramps, corridors. []- Exception 5:C405.2.1_C405.2.1.1: Requirement does not apply.	☐ ☐ ☐
6063 Controls	C405.2.1.2	Interior Lighting	Occupancy sensors control function in warehouses: In warehouses, the lighting in aisleways and open areas is controlled with occupant sensors that automatically reduce lighting power by 50% or more within 20 minutes of when the areas are unoccupied. The occupant sensors control lighting in each aisleway independently and do not control lighting beyond the aisleway being controlled by the sensor. Lights not turned off by occupant sensors is done so by time-switch. []- Exception 1:C402.5.1.2: Requirement does not apply.	☐ ☐ ☐
6066 Controls	C405.2.1.3	Interior Lighting	Occupant sensor control function in open plan office areas: Occupant sensor controls in open office spaces >= 300 sq.ft. have controls 1) configured so that general lighting can be controlled separately in control zones with floor areas <= 600 sq.ft. within the space, 2) general lighting in each zone permitted to turn on upon occupancy in control zone, 3) automatically turn off general lighting in all control zones within 20 minutes after all occupants have left the space, 4) are configured so that general lighting power in each control zone is reduced by <= 80% of the full zone general lighting power within 20 minutes of all occupants leaving that control zone. []- Exception 1:C405.2.1.3: Requirement does not apply.	☐ ☐ ☐

6067 Controls	C405.2.2, C405.2.2.1	Interior Lighting	Each area not served by occupancy sensors (per C405.2.1.1) have time-switch controls and functions detailed in sections C405.2.2.1. []- Exception 1:C405.2.2_C405.2.2.1: Luminaires requiring specific controls in accordance with C405.2.4. []- Exception 2:C405.2.2_C405.2.2.1: Spaces with patient care. []- Exception 3:C405.2.2_C405.2.2.1: Areas such as security or emergency areas that need continuous lighting. []- Exception 4:C405.2.2_C405.2.2.1: Lighting that is related to means of egress in stairways, ramps, corridors, or emergency routes. []- Exception 5:C405.2.2_C405.2.2.1: Shop and laboratory classrooms.	☐ ☐ ☐
6069 Controls	C405.2.3.1	Interior Lighting	Spaces required to have light-reduction controls have a manual control that allows the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern using one of the following or another approved method: (1) Continuous dimming of all luminaires from full output to less than 20 percent of full power, (2) Switching all luminaires to a reduced output of not less than 30 percent and not more than 70 percent of full power, or (3) Switching alternate luminaires or alternate rows of luminaires to achieve a reduced output of not less than 30 percent and not more than 70 percent of full power. []- Exception 1:C405.2: Areas designated as security or emergency areas that are required to be continuously lighted. []- Exception 2:C405.2: Interior exit stairways, interior exit ramps, and exit passageways. []- Exception 3:C405.2: Emergency egress lighting that is normally off.	☐ ☐ ☐
6070 Controls	C405.2.4, C405.2.4.1, C405.2.4.2	Interior Lighting	Daylight zones provided with individual controls that control the lights independent of general area lighting. See code section C405.2.3 Daylight-responsive controls for applicable spaces, C405.2.3.1 Daylight responsive control function and section C405.2.3.2 Sidelit zone. []- Exception 1:C405.2.4: Spaces where health patient care is directly provided. []- Exception 2:C405.2.4: Lighting required to have specific application controls. []- Exception 3:C405.2.4: Sidelit zones on first floor in Group A-2 and M occupancies. []- Exception 4:C405.2.4: New buildings having total connected lighting power <= the adjusted interior lighting powered allowance (LPA adj, refer to section details and formula). []- Exception 5:C405.2.4: Requirement does not apply.	☐ ☐ ☐

6074 Wattage	C405.2.5	Interior Lighting	Additional interior lighting power allowed for special functions per the approved lighting plans and is automatically controlled and separated from general lighting. []- Exception 1:C405.7: Air-over electric motors. []- Exception 2:C405.7: Component sets of an electric motor. []- Exception 3:C405.7: Liquid-cooled electric motors. []- Exception 4:C405.7: Submersible electric motors. []- Exception 5:C405.7: Inverter-only electric motors. []- Exception 6:C405.7: Requirement does not apply.	☐	☐	☐
6077 Controls	C405.2.7	Exterior Lighting	Automatic lighting controls for exterior lighting installed. Controls will be daylight controlled, set based on business operation time-of-day, or reduce connected lighting > 50%. []- Exception 1:C405.2.7: Lighting for covered vehicle entrances and exits from buildings and parking structures where required for eye adaptation []- Exception 2:C405.2.7: Lighting controlled from within dwelling units []- Exception 3:C405.2.7: Requirement does not apply.	☐	☐	☐
6131 Wattage	C405.4.1	Exterior Lighting	Exterior lighting power is consistent with what is shown on the approved lighting plans, demonstrating proposed watts are less than or equal to allowed watts.	☐	☐	☐
6132 Mandatory Additior	C406.10	Project	Energy Monitoring - the building is equipped with an energy management system to monitor, record, and report energy consumption for electrical energy, by end-use category, contain meters, a data acquisition system and employ graphical reports.	☐	☐	☐
6133 Mandatory Additior	C406.11	Project	Fault Detection and Diagnostics - a fault detection and diagnostics system installed to monitor the HVAC operation and performance. Includes monitoring sensors and devices, sampling every 15 minutes, automatically report faults and provide recommendations for repair, and transmit recommendations to local authorized personnel.	☐	☐	☐
6134 Mandatory Additior	C406.12	Project	Efficient Kitchen Equipment - the commercial kitchen has at least one fryer with all fryers, dishwashers, steam cookers and ovens complying with performance requirements of Tables C406.12(1) through C406.12(4).	☐	☐	☐
6185 Mandatory Additior	C406.2	Project	Equipment shall exceed the minimum efficiency requirements listed in Tables C403.2.3(1) through C403.2.3(7) by 10 %, in addition to the requirements of Section C403	☐	☐	☐
6135 Mandatory Additior	C406.2.1	Project	5% heating efficiency improvement - all HVAC and Plant heating equipment is 5% more efficient than required by 2021 IECC.	☐	☐	☐
6136 Mandatory Additior	C406.2.2	Project	5% cooling efficiency improvement - all HVAC and Plant cooling equipment is 5% more efficient than required by 2021 IECC.	☐	☐	☐

6137 Mandatory Additior	C406.2.3	Project	10% heating efficiency improvement - all HVAC and Plant heating equipment is 10% more efficient than required by 2021 IECC.	☐	☐	☐
6138 Mandatory Additior	C406.2.4	Project	10% cooling efficiency improvement - all HVAC and Plant cooling equipment is 10% more efficient than required by 2021 IECC.	☐	☐	☐
6139 Mandatory Additior	C406.3	Project	Reduced lighting power - this credit specifies that the connected lighting power is <= 10% more efficient than 2021 IECC requirements.	☐	☐	☐
6140 Mandatory Additior	C406.4	Project	Enhanced Digital Lighting Controls - Interior lighting has the following enhanced lighting controls in accordance with Sections C405.2.1 through C405.2.3, Luminaires capable of continuous dimming and being addressed individually, at least 8 luminaires controlled in combination in a daylight zone, digital control system for fixtures with load shedding or occupancy sensors, Sequence of Operations documentation, and functional testing per Section C408.	☐	☐	☐
6143 Mandatory Additior	C406.5	Project	On-site renewable energy credits - on-site renewable energy system supplies at least 1.71 Btuh or 0.5 watts per square foot of conditioned floor area OR provides at least 2 percent of the energy used within the building for mechanical and service water heating equipment and lighting regulated in Chapter 4.	☐	☐	☐
6145 Mandatory Additior	C406.7.1	Project	Reduced energy use in service water heating - the hot water system contains waste heat recovery from service hot water, heat-recovery chillers, building equipment or process equipment or on-site renewable energy for water heating.	☐	☐	☐
6146 Mandatory Additior	C406.7.3	Project	Reduced energy use in service water heating - the hot water heating system shall have a capacity weighted average fossil fuel water heating efficiency at least 95 thermal efficiency or 0.95 EF.	☐	☐	☐
6147 Mandatory Additior	C406.7.4	Project	Reduced energy use in service water heating - the hot water system is served by heat pump water heaters with a minimum Energy Factor of 3.0. The heat pump does not draw conditioned air from within the building.	☐	☐	☐
6148 Mandatory Additior	C406.8	Project	Enhanced envelope performance - the building thermal envelope UA value is >= 15% better than the total UA of the envelope specified by Section C402.1.5.	☐	☐	☐
6149 Mandatory Additior	C406.9	Project	Reduced air infiltration energy - the measured air-leakage rate of the building envelope is lower than 0.25 cfm/ft2. Comprehensive report documentation will be submitted to the code official and the building owner. []- Exception 1:C406.9: Building is greater than 250,000 square feet.	☐	☐	☐
6083 HVAC	C408.2.2.1	Mechanical	Air outlets and zone terminal devices have means for air balancing. []- Exception 1:C408.2.2.1: Fans with fan motors of 1 hp (0.74 kW) or less. []- Exception 2:C408.2.2.1: Where throttling results in no greater than 1/3 hp fan horsepower draw above that required if the fan speed were adjusted []- Exception 3:C408.2.2.1: Requirement does not apply.	☐	☐	☐

6153 Testing	C408.2.3.2	Mechanical	HVAC and service water heating control systems have been tested to ensure proper operation, calibration and adjustment of controls.	☐	☐	☐
6104 SYSTEM_SPECIF	Table_C403.2.3b	Mechanical	Heat Rejection Equipment - Propeller or Axial Fan Open-Circuit Cooling Tower: Minimum Efficiency Requirement >=40.2 gpm/hp .	☐	☐	☐
6105 SYSTEM_SPECIF	Table_C403.2.3b	Mechanical	Heat Rejection Equipment - Centrifugal Fan Open-Circuit Cooling Tower: Minimum Efficiency Requirement >=20.0 gpm/hp.	☐	☐	☐
6106 SYSTEM_SPECIF	Table_C403.2.3c	Mechanical	Heat Rejection Equipment - Propeller or Axial Fan Closed-Circuit Cooling Tower: Minimum Efficiency Requirement >=16.1 gpm/hp.	☐	☐	☐
6109 SYSTEM_SPECIF	Table_C403.2.3c	Mechanical	Heat Rejection Equipment - Centrifugal Fan Closed-Circuit Cooling Tower: Minimum Efficiency Requirement >=7.0 gpm/hp	☐	☐	☐
6186 SYSTEM_SPECIF	Table_C403.2.3d	Mechanical	Heat Rejection Equipment - Propeller or Axial Fan Dry Coolers (air-cooled fluid coolers): Minimum Efficiency Requirement >= 4.5 gpm/hp	☐	☐	☐
6111 SYSTEM_SPECIFI	Table_C403.2.3h	Mechanical	Heat Rejection Equipment - Propeller or Axial Evaporative Condenser: Minimum Efficiency Requirement >=134 kBtu/h-hp w/ Ammonia test fluid.	☐	☐	☐
6112 SYSTEM_SPECIFI	Table_C403.2.3h	Mechanical	Heat Rejection Equipment - Centrifugal Evaporative Condenser: Minimum Efficiency Requirement >=110 kBtu/h-hp w/ Ammonia test fluid.	☐	☐	☐
6117 SYSTEM_SPECIFI	Table_C403.2.3h	Mechanical	Heat Rejection Equipment - Propeller or Axial Evaporative Condenser: Minimum Efficiency Requirement >=160 kBtu/h-hp w/ R-448A test fluid.	☐	☐	☐
6119 SYSTEM_SPECIFI	Table_C403.2.3h	Mechanical	Heat Rejection Equipment - Centrifugal Evaporative Condenser: Minimum Efficiency Requirement >=137 kBtu/h-hp w/ R-448A test fluid.	☐	☐	☐
6121 SYSTEM_SPECIF	Table_C403.2.3h	Mechanical	Heat Rejection Equipment - Air-Cooled Condensers: Minimum Efficiency Requirement >=176 kBtu/h-hp	☐	☐	☐

4. To be checked by Inspector at Project Completion and Prior to Issuance of Certificate of Occupancy

6041 Fenestration	C402.4.2.2	Envelope	Skylights in office, storage, automotive service, manufacturing, non-refrigerated warehouse, retail store, and distribution/sorting area have a measured haze value < 90 percent tested per ASTM D1003 unless designed to exclude direct sunlight. []- Exception 1:C402.4.2.2: Skylights designed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles, geometry of skylight and well, or optical diffusers. []- Exception 2:C402.4.2.2: Requirement does not apply.	☐	☐	☐
6179 Post Construction	C405.1	Project	At least 90% of dwelling unit permanently installed lighting shall have lamp efficacy <= 65 lm/W or luminaires with efficacy <= 45 lm/W or comply with C405.2.4 or C405.3. []- Exception 1:C405.1: Requirement does not apply.	☐	☐	☐

6180 Post Construction	C405.11, C405.11.1	Project	50% of 15/20 amp receptacles installed in enclosed offices, conference rooms, copy rooms, break rooms, classrooms and workstations and < 25% of branch circuit feeders for modular furniture will have automatic receptacle control in accordance with C405.11.1. []- Exception 1:C405.11_C405.11.1: Requirement does not apply.	☐	☐	☐
6181 Post Construction	C405.12	Project	Buildings with gross conditioned floor area >= 25,000 ft2 will be equipped with a energy monitoring system in compliance with C405.12.1 through C405.12.5. []- Exception 1:C405.12: Requirement does not apply.	☐	☐	☐
6079 Post Construction	C405.5.3	Project	Total voltage drop across the combination of feeders and branch circuits <= 5%. []- Exception 1:C405.5.3: Requirement does not apply.	☐	☐	☐
6073 Post Construction	C405.6	Project	Low-voltage dry-type distribution electric transformers meet the minimum efficiency requirements of Table C405.6. []- Exception 1:C405.6: Transformers meet the Energy Policy Act of 2005 special purposes exclusions. []- Exception 2:C405.6: Transformers meet the Energy Policy Act of 2005 non-general purpose exclusions. []- Exception 3:C405.6: Transformers meet the Energy Policy Act of 2005 exclusions with multiple voltage taps where the highest tap is >= 20% more than the lowest tap. []- Exception 4:C405.6: Drive transformers. []- Exception 5:C405.6: Rectifier transformers. []- Exception 6:C405.6: Auto-transformers. []- Exception 7:C405.6: Uninterruptible power system transformers. []- Exception 8:C405.6: Impedance transformers. []- Exception 9:C405.6: Regulating transformers. []- Exception 10:C405.6: Sealed and nonventilating transformers. []- Exception 11:C405.6: Machine tool transformers. []- Exception 12:C405.6: Welding transformers. []- Exception 13:C405.6: Grounding transformers. []- Exception 14:C405.6: Testing transformers. []- Exception 15:C405.6: Requirement does not apply.	☐	☐	☐
6075 Post Construction	C405.7	Project	Electric motors meet the minimum efficiency requirements of Tables C405.7(1) through C405.7(4). Efficiency verified through certification under an approved certification program or the equipment efficiency ratings shall be provided by motor manufacturer (where certification programs do not exist).	☐	☐	☐

6078	Post Construction	C405.8.1, C405.8.2	Project	Escalators and moving walks comply with ASME A17.1/CSA B44 and have automatic controls configured to reduce speed to the minimum permitted speed in accordance with ASME A17.1/CSA B44 or applicable local code when not conveying passengers. []- Exception 1:C405.8.1_C405.8.2: A variable voltage drive system that reduces operating voltage in response to light loading is installed. []- Exception 2:C405.9.1_C405.9.2: Requirement does not apply.	☐	☐	☐
6150	Post Construction	C408.1.1	Project	Building operations and maintenance documents will be provided to the owner. Documents will cover manufacturers' information, specifications, programming procedures and means of illustrating to owner how building, equipment and systems are intended to be installed, maintained, and operated.	☐	☐	☐
6151	Post Construction	C408.2.1	Mechanical	Commissioning plan developed by registered design professional or approved agency.	☐	☐	☐
6152	Post Construction	C408.2.3.1	Mechanical	HVAC equipment, systems and system-to-system relationships have been tested to ensure proper operation. []- Exception 1:C408.2.3.1: Unitary or packaged HVAC equipment without supply air economizers.	☐	☐	☐
6154	Post Construction	C408.2.3.3	Mechanical	Economizers have been tested to ensure proper operation.	☐	☐	☐
6156	Post Construction	C408.2.4	Mechanical	Preliminary commissioning report completed and certified by registered design professional or approved agency.	☐	☐	☐
6176	Post Construction	C408.2.5	Mechanical	Furnished HVAC as-built drawings submitted within 90 days of system acceptance.	☐	☐	☐
6018	Post Construction	C408.2.5.2	Mechanical	Furnished Operation and Maintenance manuals for HVAC systems within 90 days of system acceptance.	☐	☐	☐
6182	Post Construction	C408.2.5.3	Mechanical	An air and/or hydronic system balancing report is provided for HVAC systems.	☐	☐	☐
6183	Post Construction	C408.2.5.4	Mechanical	Final commissioning report due to building owner within 90 days of receipt of certificate of occupancy.	☐	☐	☐
6184	Post Construction	C408.3	Interior Lighting	Lighting systems have been tested to ensure proper calibration, adjustment, programming, and operation.	☐	☐	☐
6177	Post Construction	C408.3.2	Interior Lighting	Furnished as-built drawings for electric power systems within 90 days of system acceptance.	☐	☐	☐
6017	Post Construction	C408.3.2.2	Interior Lighting	Furnished operation and maintenance manual for lighting equipment and lighting controls provided to the building owner or designated representative.	☐	☐	☐

Input Data Report

Project Information

Project Name: I22509 **Project Title:** THE GULF COAST REHABILITATION CENTER

Address: 1937 JENKS AVENUE **State:** FLORIDA **Zip:** 32405

Owner:

Building Type: Healthcare-Clinic **Building Classification:** New Finished building

No.of Stories: 2 **GrossArea (SF):** 67,668

Bldg. Rotation: None

Zones

No	Acronym	Description	Type	Area [sf]	Multi	Total Area [sf]	
1	FCU-1.1	FCU-1.1	CONDITIONED	476.0	1	476.0	☐
2	FCU-1.2	FCU-1.2	CONDITIONED	257.6	1	257.6	☐
3	FCU-1.3	FCU-1.3	CONDITIONED	164.5	1	164.5	☐
4	FCU-1.4	FCU-1.4	CONDITIONED	626.2	1	626.2	☐
5	FCU-1.5	FCU-1.5	CONDITIONED	1358.0	1	1358.0	☐
6	FCU-1.6	FCU-1.6	CONDITIONED	742.0	1	742.0	☐
7	FCU-1.7	FCU-1.7	CONDITIONED	792.4	1	792.4	☐
8	FCU-1.8	FCU-1.8	CONDITIONED	755.3	1	755.3	☐
9	FCU-1.9	FCU-1.9	CONDITIONED	396.2	1	396.2	☐
10	FCU-1.10	FCU-1.10	CONDITIONED	419.3	1	419.3	☐
11	FCU-1.11	FCU-1.11	CONDITIONED	548.1	1	548.1	☐
12	FCU-1.12	FCU-1.12	CONDITIONED	329.7	1	329.7	☐
13	FCU-1.13	FCU-1.13	CONDITIONED	2616.6	1	2616.6	☐
14	FCU-1.14	FCU-1.14	CONDITIONED	410.9	1	410.9	☐
15	FCU-1.15	FCU-1.15	CONDITIONED	881.3	1	881.3	☐
16	FCU-1.16	FCU-1.16	CONDITIONED	362.6	1	362.6	☐
17	FCU-1.17	FCU-1.17	CONDITIONED	1401.1	1	1401.1	☐
18	FCU-1.18	FCU-1.18	CONDITIONED	1673.0	1	1673.0	☐
19	FCU-1.19	FCU-1.19	CONDITIONED	996.1	1	996.1	☐
20	FCU-1.20	FCU-1.20	CONDITIONED	289.8	1	289.8	☐
21	FCU-1.21	FCU-1.21	CONDITIONED	444.5	1	444.5	☐
22	FCU-1.22A	FCU-1.22A	CONDITIONED	214.1	1	214.1	☐
23	FCU-1.22B	FCU-1.22B	CONDITIONED	744.1	1	744.1	☐
24	FCU-2.1	FCU-2.1	CONDITIONED	277.9	1	277.9	☐
25	FCU-2.2	FCU-2.2	CONDITIONED	1297.9	1	1297.9	☐
26	FCU-2.3	FCU-2.3	CONDITIONED	980.7	1	980.7	☐
27	FCU-2.4	FCU-2.4	CONDITIONED	219.1	1	219.1	☐
28	FCU-2.5	FCU-2.5	CONDITIONED	875.7	1	875.7	☐
29	FCU-2.6	FCU-2.6	CONDITIONED	989.8	1	989.8	☐
30	FCU-2.7	FCU-2.7	CONDITIONED	1651.3	1	1651.3	☐
31	FCU-2.8	FCU-2.8	CONDITIONED	289.8	1	289.8	☐
32	FCU-2.9	FCU-2.9	CONDITIONED	982.8	1	982.8	☐
33	FCU-2.10	FCU-2.10	CONDITIONED	599.9	1	599.9	☐
34	AC-1.1	AC-1.1	CONDITIONED	179.0	1	179.0	☐
35	AC-1.2	AC-1.2	CONDITIONED	169.0	1	169.0	☐
36	AC-1.3	AC-1.3	CONDITIONED	104.0	1	104.0	☐
37	AC-1.4	AC-1.4	CONDITIONED	99.0	1	99.0	☐
38	AC-1.5	AC-1.5	CONDITIONED	252.0	1	252.0	☐
39	AC-2.1	AC-2.1	CONDITIONED	96.0	1	96.0	☐
40	AC-2.2	AC-2.2	CONDITIONED	109.0	1	109.0	☐
41	SEMI PRV-L1-AREA458	FCU-A/ AREA-458	CONDITIONED	320.6	6	1923.6	☐
42	SEMI PRV-L1-AREA458	FCU-A/ AREA-458	CONDITIONED	320.6	6	1923.6	☐
43	SEMI PRV-L1-AREA562	FCU-A/ AREA-562	CONDITIONED	393.4	1	393.4	☐
44	SEMI PRV-L1-AREA586	FCU-A/ AREA-586	CONDITIONED	410.2	1	410.2	☐
45	SEMI PRV-L1-AREA437	FCU-A/ AREA-437	CONDITIONED	305.9	1	305.9	☐

46	SEMI PRV-L1-ARE A476	FCU-A/ AREA-476	CONDITIONED	333.2	2	666.4	☐
47	SEMI PRV-L1-ARE A516	FCU-A/ AREA-516	CONDITIONED	361.2	1	361.2	☐
48	SEMI PRV-L2-ARE A458	FCU-A/ AREA-458	CONDITIONED	320.6	8	2564.8	☐
49	SEMI PRV-L2-ARE A458	FCU-A/ AREA-458	CONDITIONED	320.6	8	2564.8	☐
50	SEMI PRV-L2-ARE A458	FCU-A/ AREA-458	CONDITIONED	320.6	7	2244.2	☐
51	SEMI PRV-L2-ARE A478	FCU-A/ AREA-478	CONDITIONED	334.6	4	1338.4	☐
52	SEMI PRV-L2-ARE A610	FCU-A/ AREA-610	CONDITIONED	427.0	1	427.0	☐
53	SEMI PRV-L2-ARE A465	FCU-A/ AREA-465	CONDITIONED	325.5	1	325.5	☐
54	SEMI PRV-L2-ARE A451	FCU-A/ AREA-451	CONDITIONED	315.4	1	315.4	☐
55	SEMI PRV-L2-ARE A473	FCU-A/ AREA-473	CONDITIONED	331.1	1	331.1	☐
56	SEMI PRV-L2-ARE A521	FCU-A/ AREA-521	CONDITIONED	364.7	1	364.7	☐
57	SEMI PRV-L2-ARE A564	FCU-A/ AREA-564	CONDITIONED	394.8	1	394.8	☐
58	SEMI PRV-L2-ARE A476	FCU-A/ AREA-476	CONDITIONED	333.2	2	666.4	☐
59	SEMI PRV-L2-ARE A516	FCU-A/ AREA-516	CONDITIONED	361.2	1	361.2	☐
60	SEMI PRV-L2-ARE A588	FCU-A/ AREA-588	CONDITIONED	411.6	1	411.6	☐
61	SEMI PRV-L2-ARE A437	FCU-A/ AREA-437	CONDITIONED	305.9	2	611.8	☐
62	PRV-L2-ARE A470	FCU-A/ AREA-470	CONDITIONED	329.0	1	329.0	☐
63	PRV-L2-ARE A480	FCU-A/ AREA-480	CONDITIONED	336.0	1	336.0	☐
64	PRV-L2-ARE A395	FCU-A/ AREA-395	CONDITIONED	276.5	1	276.5	☐
65	MAU-1	MAU-1 WITH 30% AREA	CONDITIONED	5279.8	1	5279.8	☐
66	MAU-2	MAU-2 WITH 30% AREA	CONDITIONED	4212.6	1	4212.6	☐
67	MAU-3	MAU-3 WITH 30% AREA	CONDITIONED	6154.1	1	6154.1	☐
68	MAU-4	MAU-4 WITH 30% AREA	CONDITIONED	4137.8	1	4137.8	☐

69	STAIR-132	STAIR-132	CONDITIONED	200.0	1	200.0	☐
70	STAIR-157	STAIR-157	CONDITIONED	200.0	1	200.0	☐
71	STAIR-187	STAIR-187	CONDITIONED	229.0	1	229.0	☐
72	STAIR-132	STAIR-132	CONDITIONED	200.0	1	200.0	☐
73	UNCONDITIONED	UNCONDITIONED	UNCONDITIONED	1135.0	1	1135.0	☐

Spaces

No	Acronym	Description	Type	Depth [ft]	Width [ft]	Height [ft]	Mult	Total Area [sf]	Total Vol[cf]
In Zone: FCU-1.1									
1	141 SPEECH TH	141 SPEECH THERAPY	Office - Enclosed	1.00	83.30	13.60	1	83.3	1132.9
2	142 COUNSELI	142 COUNSELING	Office - Enclosed	1.00	76.30	13.60	1	76.3	1037.7
3	143 UNIT MAN	143 UNIT MANG. OFFICE	Office - Enclosed	1.00	76.30	13.60	1	76.3	1037.7
4	144 HALL.	144 HALL	Corridor	1.00	79.10	13.60	1	79.1	1075.8
5	145 ADMI. OFF	145 ADMISSIONS OFFICE	Office - Enclosed	1.00	80.50	13.60	1	80.5	1094.8
6	146 PLAN OFFI	146 PLAN OFFICE	Office - Enclosed	1.00	80.50	13.60	1	80.5	1094.8
In Zone: FCU-1.2									
1	139 BEAUTY S/	139 BEAUTY SALON	Dressing/Locker/Fitting Room (General)	1.00	187.60	13.60	1	187.6	2551.4
2	140 SALON TLT	140 SALON TLT	Toilet and Washroom	1.00	70.00	13.60	1	70.0	952.0
In Zone: FCU-1.3									
1	131 OCUU. THE	131 COCCUPATIONAL THERAPY	Food Service - Kitchen	1.00	164.50	13.60	1	164.5	2237.2
In Zone: FCU-1.4									
1	124 ADMIN OFI	124 ADMIN OFFICE	Office - Enclosed	1.00	135.10	13.60	1	135.1	1837.4
2	125 RECEPTION	125 RECEPTION	Lobby (General) - Reception and Waiting	1.00	131.60	13.60	1	131.6	1789.8
3	126 MEETING F	126 CARE PLAN MEETING ROOM	Conference/meeting (Multiple Functions)	1.00	165.90	13.60	1	165.9	2256.2
4	128 PUB TLT	128 PUB TLT	Toilet and Washroom	1.00	58.10	13.60	1	58.1	790.2
5	129 PUB TLT	129 PUB TLT	Toilet and Washroom	1.00	85.10	13.60	1	85.1	1157.4
6	127 MAIL RM.	127 MAIL RM.	Storage & Warehouse - Bulky Active Storage	1.00	50.40	13.60	1	50.4	685.4
In Zone: FCU-1.5									
1	121 VESTIBUL	121 VESTIBUL	Corridor	1.00	113.40	13.60	1	113.4	1542.2
2	122 LOBBY	122 LOBBY / NORTH AND SOUTH LOBBY	Lobby (General) - Reception and Waiting	1.00	512.40	26.60	1	512.4	13629.8
3	123 ELEV. LOBI	123 ELEV. LOBBY	Lobby (General) - Reception and Waiting	1.00	732.20	13.60	1	732.2	9957.9
In Zone: FCU-1.6									
1	130 PHYSCIAL	130 PHYSCICAL THERPAY-UPPER	Exam/Treatment (Hospital)	1.00	742.00	13.60	1	742.0	10091.2
In Zone: FCU-1.7									
1	130 PHYSCIAL	130 PHYSCICAL THERPAY-UPPER	Exam/Treatment (Hospital)	1.00	792.40	13.60	1	792.4	10776.6
In Zone: FCU-1.8									
1	152B CORRIDO	152B CORRIDOR	Corridor	1.00	755.30	13.60	1	755.3	10272.1
In Zone: FCU-1.9									
1	133 PHYSCIAL	133 PHYSCICAL THERPAY	Exam/Treatment (Hospital)	1.00	268.10	13.60	1	268.1	3646.2
2	134 PT. RECEPT	134 PT. RECEPTION	Lobby (General) - Reception and Waiting	1.00	128.10	13.60	1	128.1	1742.2
In Zone: FCU-1.10									
1	135 INDIVIDUA	135 INDIVIDUAL TREATMENT	Exam/Treatment (Hospital)	1.00	118.30	13.60	1	118.3	1608.9
2	137 TRAT. ROO	137 TRAT. ROOM	Exam/Treatment (Hospital)	1.00	119.00	13.60	1	119.0	1618.4
3	138 EXAM ROC	138 EXAM ROOM	Exam/Treatment (Hospital)	1.00	99.40	13.60	1	99.4	1351.8

4	136 HALL	136 HALL	Corridor	1.00	82.60	13.60	1	82.6	1123.4
In Zone:	**FCU-1.11**								
1	154 CONFEREN	154 CONFERENCE ROOM	Conference/meeting (Multiple Functions)	1.00	336.00	13.60	1	336.0	4569.6
2	153 P.T STORA(	153 P.T STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	212.10	13.60	1	212.1	2884.6
In Zone:	**FCU-1.12**								
1	147 ACC. OFFIC	147 ACC. OFFICE	Office - Open Plan	1.00	74.20	13.60	1	74.2	1009.1
2	148 BOOKING (	148 BOOKING OFFICE	Office - Open Plan	1.00	74.20	13.60	1	74.2	1009.1
3	151 COPY ROO	151 COPY ROOM	Electrical Mechanical Equipment Room - General	1.00	46.90	13.60	1	46.9	637.8
4	150 WORK ROC	150 WORK ROOM	Office - Open Plan	1.00	67.90	13.60	1	67.9	923.4
5	149 HALL	149 HALL	Corridor	1.00	66.50	13.60	1	66.5	904.4
In Zone:	**FCU-1.13**								
1	155 MEDICAL F	155 MEDICAL RECORDS	Storage & Warehouse - Bulky Active Storage	1.00	250.60	13.60	1	250.6	3408.2
2	156 RESIDENT	156 RESIDENT STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	504.00	13.60	1	504.0	6854.4
3	158 FACILITY S	158 FACILITY STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	213.50	13.60	1	213.5	2903.6
4	162 CENTRAL S	162 CENTRAL SUPPLY	Electrical Mechanical Equipment Room - General	1.00	275.80	13.60	1	275.8	3750.9
5	163 MAIN. EQU	163 MAIN. EQUI/SPLY	Electrical Mechanical Equipment Room - General	1.00	284.90	13.60	1	284.9	3874.6
6	152 CORRIDOR	152/152A CORRIDOR	Corridor	1.00	1087.80	13.60	1	1087.8	14794.1
In Zone:	**FCU-1.14**								
1	159 STAFF LOU	159 STAFF LOUNGH	Food Service - Bar/Lounge	1.00	297.50	13.60	1	297.5	4046.0
2	160 STAFF TLT	160 STAFF TLT	Toilet and Washroom	1.00	56.70	13.60	1	56.7	771.1
3	161 STAFF TLT	161 STAFF TLT	Toilet and Washroom	1.00	56.70	13.60	1	56.7	771.1
In Zone:	**FCU-1.15**								
1	165 DINING	165 DINING WITH DINING NORTH AND SOUTH	Food Service - Leisure Dining	1.00	881.30	13.60	1	881.3	11985.7
In Zone:	**FCU-1.16**								
1	175 STORAGE	175 STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	71.40	13.60	1	71.4	971.0
2	178 STAFFT TL	178 STAFFT TLT	Toilet and Washroom	1.00	49.70	13.60	1	49.7	675.9
3	179 STAFFT TL	179 STAFFT TLT	Toilet and Washroom	1.00	49.70	13.60	1	49.7	675.9
4	170 HOUSE. OF	170 HOUSEKEEPING OFFICE	Office - Enclosed	1.00	83.30	13.60	1	83.3	1132.9
5	171 MAINT. OF	171 MAINT. OFFICE	Office - Enclosed	1.00	108.50	13.60	1	108.5	1475.6
In Zone:	**FCU-1.17**								
1	185 LAUNDRY	185 LAUNDRY	Laundry-Washing	1.00	312.20	13.60	1	312.2	4245.9
2	186 HOLDING A	186 HOLDING AREA	Storage & Warehouse - Bulky Active Storage	1.00	86.80	13.60	1	86.8	1180.5
3	172 SERVICE C(	172 SERVICE CORRIDOR	Corridor	1.00	427.00	13.60	1	427.0	5807.2
4	183 SORTING /F	183 SORTING /FOLDING	Storage & Warehouse - Bulky Active Storage	1.00	151.60	13.60	1	151.6	2061.8
5	184 LAUNDRY	184 LAUNDRY	Laundry-Washing	1.00	213.50	13.60	1	213.5	2903.6
6	177 CENTRAL (	177 CENTRAL CLEAN	Storage & Warehouse - Bulky Active Storage	1.00	68.60	13.60	1	68.6	933.0
7	173 SOLID HOL	173 SOLID HOLDING	Storage & Warehouse - Bulky Active Storage	1.00	68.60	13.60	1	68.6	933.0
8	174 WASTE MA	174 WASTE MANAGEMENT	Storage & Warehouse - Bulky Active Storage	1.00	72.80	13.60	1	72.8	990.1
In Zone:	**FCU-1.18**								
1	187B CORRIDO	187B CORRIDOR	Corridor	1.00	583.80	13.60	1	583.8	7939.7

2	187A CORRIDO	187A CORRIDOR	Corridor	1.00	725.20	13.60	1	725.2	9862.7
3	189 CLEAN UTI	189 CLEAN UTILITY	Storage & Warehouse - Bulky Active Storage	1.00	86.80	13.60	1	86.8	1180.5
4	190 SOLIED UT	190 SOLIED UTILITY	Storage & Warehouse - Bulky Active Storage	1.00	77.00	13.60	1	77.0	1047.2
5	191 SECURE ST	191 SECURE STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	65.80	13.60	1	65.8	894.9
6	192 DON OFFIC	192 DON OFFICE	Office - Enclosed	1.00	134.40	13.60	1	134.4	1827.8
In Zone:	**FCU-1.19**								
1	187C CORRIDO	187C CORRIDOR	Corridor	1.00	996.10	13.60	1	996.1	13547.0
In Zone:	**FCU-1.20**								
1	194 NURSE STA	194 NURSE STATION	Nurse Station (Hospital)	1.00	133.00	13.60	1	133.0	1808.8
2	197 STAFF TLT	197 STAFF TLT	Toilet and Washroom	1.00	49.00	13.60	1	49.0	666.4
3	196 MED RM	196 MED RM	Storage & Warehouse - Bulky Active Storage	1.00	53.90	13.60	1	53.9	733.0
4	195 NOURISH	195 NOURISH	Food Service - Bar/Lounge	1.00	53.90	13.60	1	53.9	733.0
In Zone:	**FCU-1.21**								
1	198 ACTIVITY I	198 ACTIVITY ROOM	Playing Area	1.00	444.50	13.60	1	444.5	6045.2
In Zone:	**FCU-1.22A**								
1	164 COM. KITC	164 COMMERCIAL KITCHEN UPPER	Food Service - Kitchen	1.00	141.30	13.60	1	141.3	1921.7
2	167 DIETARY O	167 DIETARY OFFICE	Office - Enclosed	1.00	72.80	13.60	1	72.8	990.1
In Zone:	**FCU-1.22B**								
1	164 COM. KITC	164 COMMERCIAL KITCHEN LOWER	Food Service - Kitchen	1.00	602.00	13.60	1	602.0	8187.2
2	164B DRY STOI	164B DRY STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	142.10	13.60	1	142.1	1932.6
In Zone:	**FCU-2.1**								
1	244 CAREPLAN	244 CAREPLAN MEETING	Conference/meeting (Multiple Functions)	1.00	204.40	13.00	1	204.4	2657.2
2	245 ADON OFFI	245 ADON OFFICE	Office - Enclosed	1.00	73.50	13.00	1	73.5	955.5
In Zone:	**FCU-2.2**								
1	249 CORRIDOR	249 CORRIDOR	Corridor	1.00	447.30	13.00	1	447.3	5814.9
2	249B CORRIDO	249B CORRIDOR	Corridor	1.00	735.10	13.00	1	735.1	9556.3
3	243 ELEV LOBI	243 ELEV LOBBY	Corridor	1.00	115.50	13.00	1	115.5	1501.5
In Zone:	**FCU-2.3**								
1	249A CORRIDO	249A CORRIDOR	Corridor	1.00	980.70	13.00	1	980.7	12749.1
In Zone:	**FCU-2.4**								
1	252 ACTIVITY I	252 ACTIVITY ROOM	Playing Area	1.00	219.10	13.00	1	219.1	2848.3
In Zone:	**FCU-2.5**								
1	255 SERVICE S	255 SERVICE STAGING	Corridor	1.00	433.30	13.00	1	433.3	5632.9
2	254 WARMIMG	254 WARMIMG KITCHEN	Food Service - Kitchen	1.00	442.40	13.00	1	442.4	5751.2
In Zone:	**FCU-2.6**								
1	253 DINING	253 DINING	Food Service - Leisure Dining	1.00	914.20	13.00	1	914.2	11884.6
2	WALKING AIDS	WALKING AIDS	Food Service - Leisure Dining	1.00	75.60	13.00	1	75.6	982.8
In Zone:	**FCU-2.7**								
1	262 CORRIDOR	262 CORRIDOR	Corridor	1.00	725.90	13.60	1	725.9	9872.2
2	262A CORRIDO	262A CORRIDOR	Corridor	1.00	699.30	13.60	1	699.3	9510.5
3	259 CLEAN UTI	259 CLEAN UTILITY	Storage & Warehouse - Bulky Active Storage	1.00	86.80	13.60	1	86.8	1180.5
4	260 SOLIED UT	1260 SOLIED UTILITY	Storage & Warehouse - Bulky Active Storage	1.00	76.30	13.60	1	76.3	1037.7

5	ASSISTED TLT	ASSISTED TLT 261B	Toilet and Washroom	1.00	63.00	13.60	1	63.0	856.8
In Zone:	**FCU-2.8**								
1	264 NURSE STA	264 NURSE STATION	Nurse Station (Hospital)	1.00	133.00	13.60	1	133.0	1808.8
2	267 STAFF TLT	267 STAFF TLT	Toilet and Washroom	1.00	49.00	13.60	1	49.0	666.4
3	266 MED RM	266 MED RM	Storage & Warehouse - Bulky Active Storage	1.00	53.90	13.60	1	53.9	733.0
4	265 NOURISH	265 NOURISH	Food Service - Bar/Lounge	1.00	53.90	13.60	1	53.9	733.0
In Zone:	**FCU-2.9**								
1	262B CORRIDO	262B CORRIDOR	Corridor	1.00	982.80	13.60	1	982.8	13366.1
In Zone:	**FCU-2.10**								
1	268 ACTIVITY I	268 ACTIVITY ROOM	Playing Area	1.00	599.90	13.60	1	599.9	8158.6
In Zone:	**AC-1.1**								
1	180A MAIN ELI	180A MAIN ELEC.	Electrical Mechanical Equipment Room - General	1.00	179.00	13.60	1	179.0	2434.4
In Zone:	**AC-1.2**								
1	180B MAIN ELI	180B MAIN ELEC.	Electrical Mechanical Equipment Room - General	1.00	169.00	13.60	1	169.0	2298.4
In Zone:	**AC-1.3**								
1	176 TELE-COM	176 TELE-COM	Electrical Mechanical Equipment Room - General	1.00	104.00	13.60	1	104.0	1414.4
In Zone:	**AC-1.4**								
1	169 ELEV. EQU	169 ELEV. EQUIP	Electrical Mechanical Equipment Room - General	1.00	99.00	13.60	1	99.0	1346.4
In Zone:	**AC-1.5**								
1	199 ELEC EQUI	199 ELEC EQUIP.	Electrical Mechanical Equipment Room - General	1.00	252.00	13.60	1	252.0	3427.2
In Zone:	**AC-2.1**								
1	257 ELEC ROOI	257 ELEC ROOM	Electrical Mechanical Equipment Room - General	1.00	96.00	13.60	1	96.0	1305.6
In Zone:	**AC-2.2**								
1	256 ELEC ROOI	256 ELEC ROOM	Electrical Mechanical Equipment Room - General	1.00	109.00	13.60	1	109.0	1482.4
In Zone:	**SEMI PRV-L1-AREA458**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	320.60	13.60	1	320.6	4360.2
In Zone:	**SEMI PRV-L1-AREA458**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	320.60	13.60	1	320.6	4360.2
In Zone:	**SEMI PRV-L1-AREA562**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	393.40	13.60	1	393.4	5350.2
In Zone:	**SEMI PRV-L1-AREA586**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	410.20	13.60	1	410.2	5578.7
In Zone:	**SEMI PRV-L1-AREA437**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	305.90	13.60	1	305.9	4160.2
In Zone:	**SEMI PRV-L1-AREA476**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	333.20	13.60	1	333.2	4531.5
In Zone:	**SEMI PRV-L1-AREA516**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	361.20	13.60	1	361.2	4912.3
In Zone:	**SEMI PRV-L2-AREA458**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	320.60	13.00	1	320.6	4167.8
In Zone:	**SEMI PRV-L2-AREA458**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	320.60	13.00	1	320.6	4167.8
In Zone:	**SEMI PRV-L2-AREA458**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	320.60	13.00	1	320.6	4167.8
In Zone:	**SEMI PRV-L2-AREA478**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	334.60	13.00	1	334.6	4349.8
In Zone:	**SEMI PRV-L2-AREA610**								

1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	427.00	13.00	1	427.0	5551.0
In Zone:	**SEMI PRV-L2-AREA465**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	325.50	13.00	1	325.5	4231.5
In Zone:	**SEMI PRV-L2-AREA451**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	315.40	13.00	1	315.4	4100.2
In Zone:	**SEMI PRV-L2-AREA473**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	331.10	13.00	1	331.1	4304.3
In Zone:	**SEMI PRV-L2-AREA521**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	364.70	13.00	1	364.7	4741.1
In Zone:	**SEMI PRV-L2-AREA564**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	394.80	13.00	1	394.8	5132.4
In Zone:	**SEMI PRV-L2-AREA476**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	333.20	13.60	1	333.2	4531.5
In Zone:	**SEMI PRV-L2-AREA516**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	361.20	13.00	1	361.2	4695.6
In Zone:	**SEMI PRV-L2-AREA588**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	411.60	13.00	1	411.6	5350.8
In Zone:	**SEMI PRV-L2-AREA437**								
1	SEMI PRV	SEMI PRV	Patient Room (Hospital)	1.00	305.90	13.60	1	305.9	4160.2
In Zone:	**PRV-L2-AREA470**								
1	PRIVATE	PRIVATE	Patient Room (Hospital)	1.00	329.00	13.00	1	329.0	4277.0
In Zone:	**PRV-L2-AREA480**								
1	PRIVATE	PRIVATE	Patient Room (Hospital)	1.00	336.00	13.00	1	336.0	4368.0
In Zone:	**PRV-L2-AREA395**								
1	PRIVATE	PRIVATE	Patient Room (Hospital)	1.00	276.50	13.00	1	276.5	3594.5
In Zone:	**MAU-1**								
1	141 SPEECH TH	141 SPEECH THERAPY	Office - Enclosed	1.00	35.70	13.60	1	35.7	485.5
2	142 COUNSELI	142 COUNSELING	Office - Enclosed	1.00	32.70	13.60	1	32.7	444.7
3	143 UNIT MAN	143 UNIT MANG. OFFICE	Office - Enclosed	1.00	24.00	13.60	1	24.0	326.4
4	144 HALL.	144 HALL	Corridor	1.00	34.50	13.60	1	34.5	469.2
5	145 ADMI. OFI	145 ADMISSIONS OFFICE	Office - Enclosed	1.00	80.50	13.60	1	80.5	1094.8
6	146 PLAN OFFI	146 PLAN OFFICE	Office - Enclosed	1.00	80.50	13.60	1	80.5	1094.8
7	139 BEAUTY S/	139 BEAUTY SALON	Dressing/Locker/Fitting Room (General)	1.00	80.40	13.60	1	80.4	1093.4
8	140 SALON TLT	140 SALON TLT	Toilet and Washroom	1.00	30.00	13.60	1	30.0	408.0
9	131 OCUU. THE	131 COCCUPATIONAL THERAPY	Food Service - Kitchen	1.00	70.50	13.60	1	70.5	958.8
10	124 ADMIN OFI	124 ADMIN OFFICE	Office - Enclosed	1.00	57.90	13.60	1	57.9	787.4
11	125 RECEPTIOI	125 RECEPTION	Lobby (General) - Reception and Waiting	1.00	56.40	13.60	1	56.4	767.0
12	126 MEETING I	126 CARE PLAN MEETING ROOM	Conference/meeting (Multiple Functions)	1.00	71.10	13.60	1	71.1	967.0
13	128 PUB TLT	128 PUB TLT	Toilet and Washroom	1.00	24.90	13.60	1	24.9	338.6
14	129 PUB TLT	129 PUB TLT	Toilet and Washroom	1.00	24.90	13.60	1	24.9	338.6
15	127 MAIL RM.	127 MAIL RM.	Storage & Warehouse - Bulky Active Storage	1.00	21.60	13.60	1	21.6	293.8
16	121 VESTIBUL	121 VESTIBUL	Corridor	1.00	48.60	13.60	1	48.6	661.0
17	122 LOBBY	122 LOBBY / NORTH AND SOUTH LOBBY	Lobby (General) - Reception and Waiting	1.00	219.60	26.60	1	219.6	5841.4

18	123 ELEV. LOBI	123 ELEV. LOBBY	Lobby (General) - Reception and Waiting	1.00	313.80	13.60	1	313.8	4267.7
19	130 PHYSCIAL	130 PHYSCICAL THERPAY-UPPER	Exam/Treatment (Hospital)	1.00	318.00	13.60	1	318.0	4324.8
20	130 PHYSCIAL	130 PHYSCICAL THERPAY-UPPER	Exam/Treatment (Hospital)	1.00	339.60	13.60	1	339.6	4618.6
21	152B CORRIDO	152B CORRIDOR	Corridor	1.00	323.70	13.60	1	323.7	4402.3
22	133 PHYSCIAL	133 PHYSCICAL THERPAY	Exam/Treatment (Hospital)	1.00	114.90	13.60	1	114.9	1562.6
23	134 PT. RECEPT	134 PT. RECEPTION	Lobby (General) - Reception and Waiting	1.00	54.90	13.60	1	54.9	746.6
24	135 INDIVIDUA	135 INDIVIDUAL TREATMENT	Exam/Treatment (Hospital)	1.00	50.70	13.60	1	50.7	689.5
25	137 TRAT. ROO	137 TRAT. ROOM	Exam/Treatment (Hospital)	1.00	51.00	13.60	1	51.0	693.6
26	138 EXAM ROC	138 EXAM ROOM	Exam/Treatment (Hospital)	1.00	42.60	13.60	1	42.6	579.4
27	136 HALL	136 HALL	Corridor	1.00	35.40	13.60	1	35.4	481.4
28	154 CONFEREN	154 CONFERENCE ROOM	Conference/meeting (Multiple Functions)	1.00	144.00	13.60	1	144.0	1958.4
29	153 P.T STORAG	153 P.T STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	90.90	13.60	1	90.9	1236.2
30	244 CAREPLAN	244 CAREPLAN MEETING	Conference/meeting (Multiple Functions)	1.00	87.60	13.00	1	87.6	1138.8
31	245 ADON OFFI	245 ADON OFFICE	Office - Enclosed	1.00	31.50	13.00	1	31.5	409.5
32	249 CORRIDOR	249 CORRIDOR	Corridor	1.00	191.70	13.00	1	191.7	2492.1
33	249B CORRIDO	249B CORRIDOR	Corridor	1.00	327.90	13.00	1	327.9	4262.7
34	243 ELEV LOBI	243 ELEV LOBBY	Corridor	1.00	49.50	13.00	1	49.5	643.5
35	SEMI PRV-458	SEMI PRV-458 L2	Patient Room (Hospital)	1.00	137.40	13.00	5	687.0	8931.0
36	SEMI PRV-478	SEMI PRV-478 L2	Patient Room (Hospital)	1.00	143.40	13.00	2	286.8	3728.4
37	SEMI PRV-610	SEMI PRV-610 L2	Patient Room (Hospital)	1.00	183.00	13.00	1	183.0	2379.0
38	PRIVATE-395	PRIVATE-395 L2	Patient Room (Hospital)	1.00	276.50	13.00	1	276.5	3594.5
39	PRIVATE-480	PRIVATE-480 L2	Patient Room (Hospital)	1.00	144.00	13.00	1	144.0	1872.0
40	PRIVATE-470	PRIVATE-470	Patient Room (Hospital)	1.00	141.00	13.00	1	141.0	1833.0
In Zone:	**MAU-2**								
1	147 ACC. OFFIC	147 ACC. OFFICE	Office - Open Plan	1.00	31.80	13.60	1	31.8	432.5
2	148 BOOKING (	148 BOOKING OFFICE	Office - Open Plan	1.00	31.80	13.60	1	31.8	432.5
3	151 COPY ROO	151 COPY ROOM	Electrical Mechanical Equipment Room - General	1.00	20.10	13.60	1	20.1	273.4
4	150 WORK ROC	150 WORK ROOM	Office - Open Plan	1.00	29.10	13.60	1	29.1	395.8
5	149 HALL	149 HALL	Corridor	1.00	28.50	13.60	1	28.5	387.6
6	155 MEDICAL F	155 MEDICAL RECORDS	Storage & Warehouse - Bulky Active Storage	1.00	107.40	13.60	1	107.4	1460.6
7	156 RESIDENT	156 RESIDENT STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	216.00	13.60	1	216.0	2937.6
8	158 FACILITY S	158 FACILITY STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	91.50	13.60	1	91.5	1244.4
9	162 CENTRAL S	162 CENTRAL SUPPLY	Electrical Mechanical Equipment Room - General	1.00	118.20	13.60	1	118.2	1607.5
10	163 MAIN. EQU	163 MAIN. EQUI/SPLY	Electrical Mechanical Equipment Room - General	1.00	122.10	13.60	1	122.1	1660.6
11	159 STAFF LOU	159 STAFF LOUNGH	Food Service - Bar/Lounge	1.00	127.50	13.60	1	127.5	1734.0
12	160 STAFF TLT	160 STAFF TLT	Toilet and Washroom	1.00	24.30	13.60	1	24.3	330.5
13	161 STAFF TLT	161 STAFF TLT	Toilet and Washroom	1.00	24.30	13.60	1	24.3	330.5

14	165 DINING	165 DINING WITH DINING NORTH AND SOUTH	Food Service - Leisure Dining	1.00	377.69	13.60	1	377.7	5136.6
15	164 COM. KITC	164 COMMERCIAL KITCHEN UPPER	Food Service - Leisure Dining	1.00	141.30	13.60	1	141.3	1921.7
16	167 DIETARY O	167 DIETARY OFFICE	Office - Enclosed	1.00	31.20	13.60	1	31.2	424.3
17	164 COM. KITC	164 COMMERCIAL KITCHEN LOWER	Food Service - Leisure Dining	1.00	258.00	13.60	1	258.0	3508.8
18	164B DRY STOI	164B DRY STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	60.90	13.60	1	60.9	828.2
19	249A CORRIDO	249A CORRIDOR	Corridor	1.00	420.30	13.00	1	420.3	5463.9
20	252 ACTIVITY I	252 ACTIVITY ROOM	Playing Area	1.00	93.90	13.00	1	93.9	1220.7
21	SEMI PRV-458	SEMI PRV-458 L2	Patient Room (Hospital)	1.00	137.40	13.00	5	687.0	8931.0
22	SEMI PRV-478	SEMI PRV-478 L2	Patient Room (Hospital)	1.00	143.40	13.00	2	286.8	3728.4
23	SEMI PRV-473	SEMI PRV-473 L2	Patient Room (Hospital)	1.00	141.90	13.00	1	141.9	1844.7
24	SEMI PRV-451	SEMI PRV-451 L2	Patient Room (Hospital)	1.00	135.30	13.00	1	135.3	1758.9
25	SEMI PRV-465	SEMI PRV-465 L2	Patient Room (Hospital)	1.00	139.50	13.00	1	139.5	1813.5
26	152 CORRIDOR	152/152A CORRIDOR	Corridor	1.00	466.20	13.60	1	466.2	6340.3
In Zone:	**MAU-3**								
1	175 STORAGE	175 STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	71.40	13.60	1	71.4	971.0
2	178 STAFFT TL	178 STAFFT TLT	Storage & Warehouse - Bulky Active Storage	1.00	49.70	13.60	1	49.7	675.9
3	179 STAFFT TL	179 STAFFT TLT	Storage & Warehouse - Bulky Active Storage	1.00	21.30	13.60	1	21.3	289.7
4	170 HOUSE. OF	170 HOUSEKEEPING OFFICE	Office - Enclosed	1.00	35.70	13.60	1	35.7	485.5
5	171 MAINT. OFI	171 MAINT. OFFICE	Office - Enclosed	1.00	46.50	13.60	1	46.5	632.4
6	185 LAUNDRY	185 LAUNDRY	Laundry-Washing	1.00	133.80	13.60	1	133.8	1819.7
7	186 HOLDING A	186 HOLDING AREA	Storage & Warehouse - Bulky Active Storage	1.00	37.20	13.60	1	37.2	505.9
8	172 SERVICE C	172 SERVICE CORRIDOR	Corridor	1.00	183.00	13.60	1	183.0	2488.8
9	183 SORTING /I	183 SORTING /FOLDING	Storage & Warehouse - Bulky Active Storage	1.00	65.10	13.60	1	65.1	885.4
10	184 LAUNDRY	184 LAUNDRY	Laundry-Washing	1.00	91.50	13.60	1	91.5	1244.4
11	177 CENTRAL (	177 CENTRAL CLEAN	Storage & Warehouse - Bulky Active Storage	1.00	29.40	13.60	1	29.4	399.8
12	173 SOLID HOL	173 SOLID HOLDING	Storage & Warehouse - Bulky Active Storage	1.00	29.40	13.60	1	29.4	399.8
13	174 WASTE MA	174 WASTE MANAGEMENT	Storage & Warehouse - Bulky Active Storage	1.00	31.20	13.60	1	31.2	424.3
14	187B CORRIDO	187B CORRIDOR	Corridor	1.00	250.20	13.60	1	250.2	3402.7
15	187A CORRIDO	187A CORRIDOR	Corridor	1.00	310.80	13.60	1	310.8	4226.9
16	189 CLEAN UTI	189 CLEAN UTILITY	Storage & Warehouse - Bulky Active Storage	1.00	37.20	13.60	1	37.2	505.9
17	190 SOLIED UT	190 SOLIED UTILITY	Storage & Warehouse - Bulky Active Storage	1.00	33.00	13.60	1	33.0	448.8
18	191 SECURE ST	191 SECURE STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	28.20	13.60	1	28.2	383.5
19	192 DON OFFIC	192 DON OFFICE	Office - Enclosed	1.00	57.60	13.60	1	57.6	783.4
20	255 SERVICE S	255 SERVICE STAGING	Corridor	1.00	185.70	13.00	1	185.7	2414.1
21	254 WARMIMG	254 WARMIMG KITCHEN	Food Service - Kitchen	1.00	189.60	13.00	1	189.6	2464.8
22	253 DINING	253 DINING	Food Service - Leisure Dining	1.00	391.80	13.00	1	391.8	5093.4
23	WALKING AIDS	WALKING AIDS	Food Service - Leisure Dining	1.00	32.40	13.00	1	32.4	421.2

24	262 CORRIDOR	262 CORRIDOR	Corridor	1.00	311.10	13.60	1	311.1	4231.0
25	262A CORRIDO	262A CORRIDOR	Corridor	1.00	299.70	13.60	1	299.7	4075.9
26	259 CLEAN UTI	259 CLEAN UTILITY	Storage & Warehouse - Bulky Active Storage	1.00	37.20	13.60	1	37.2	505.9
27	260 SOLIED UT	1260 SOLIED UTILITY	Storage & Warehouse - Bulky Active Storage	1.00	32.70	13.60	1	32.7	444.7
28	ASSISTED TLT	ASSISTED TLT 261B	Toilet and Washroom	1.00	27.00	13.60	1	27.0	367.2
29	SEMI PRV-458	SEMI PRV-458 L1	Patient Room (Hospital)	1.00	137.40	13.60	5	687.0	9343.2
30	SEMI PRV-458	SEMI PRV-458 L1	Patient Room (Hospital)	1.00	137.40	13.60	5	687.0	9343.2
31	SEMI PRV-562	SEMI PRV-562 L1	Patient Room (Hospital)	1.00	168.60	13.60	1	168.6	2293.0
32	SEMI PRV-458	SEMI PRV-458 L2	Patient Room (Hospital)	1.00	137.40	13.00	9	1236.6	16075.8
33	SEMI PRV-521	SEMI PRV-521 L2	Patient Room (Hospital)	1.00	156.30	13.00	1	156.3	2031.9
34	SEMI PRV-564	SEMI PRV-564 L2	Patient Room (Hospital)	1.00	169.20	13.00	1	169.2	2199.6
In Zone:	**MAU-4**								
1	187C CORRIDO	187C CORRIDOR	Corridor	1.00	426.80	13.60	1	426.8	5804.5
2	194 NURSE STA	194 NURSE STATION	Nurse Station (Hospital)	1.00	57.00	13.60	1	57.0	775.2
3	197 STAFF TLT	197 STAFF TLT	Toilet and Washroom	1.00	21.00	13.60	1	21.0	285.6
4	196 MED RM	196 MED RM	Storage & Warehouse - Bulky Active Storage	1.00	23.10	13.60	1	23.1	314.2
5	195 NOURISH	195 NOURISH	Food Service - Bar/Lounge	1.00	23.10	13.60	1	23.1	314.2
6	198 ACTIVITY I	198 ACTIVITY ROOM	Playing Area	1.00	190.50	13.60	1	190.5	2590.8
7	264 NURSE STA	264 NURSE STATION	Nurse Station (Hospital)	1.00	57.00	13.60	1	57.0	775.2
8	267 STAFF TLT	267 STAFF TLT	Toilet and Washroom	1.00	21.00	13.60	1	21.0	285.6
9	266 MED RM	266 MED RM	Storage & Warehouse - Bulky Active Storage	1.00	23.10	13.60	1	23.1	314.2
10	265 NOURISH	265 NOURISH	Food Service - Bar/Lounge	1.00	23.10	13.60	1	23.1	314.2
11	262B CORRIDO	262B CORRIDOR	Corridor	1.00	421.20	13.60	1	421.2	5728.3
12	268 ACTIVITY I	268 ACTIVITY ROOM	Playing Area	1.00	257.10	13.60	1	257.1	3496.6
13	SEMI PRV-476	SEMI PRV-476 L1	Patient Room (Hospital)	1.00	142.80	13.60	2	285.6	3884.2
14	SEMI PRV-458	SEMI PRV-458 L1	Patient Room (Hospital)	1.00	137.40	13.60	4	549.6	7474.6
15	SEMI PRV-516	SEMI PRV-516 L1	Patient Room (Hospital)	1.00	154.80	13.60	1	154.8	2105.3
16	SEMI PRV-586	SEMI PRV-586 L1	Patient Room (Hospital)	1.00	175.80	13.60	1	175.8	2390.9
17	SEMI PRV-437	SEMI PRV-437 L1	Patient Room (Hospital)	1.00	131.10	13.60	1	131.1	1783.0
18	SEMI PRV-476	SEMI PRV-476 L2	Patient Room (Hospital)	1.00	142.80	13.00	2	285.6	3712.8
19	SEMI PRV-458	SEMI PRV-458 L2	Patient Room (Hospital)	1.00	137.40	13.00	4	549.6	7144.8
20	SEMI PRV-516	SEMI PRV-516 L2	Patient Room (Hospital)	1.00	154.80	13.00	1	154.8	2012.4
21	SEMI PRV-586	SEMI PRV-586 L1	Patient Room (Hospital)	1.00	175.80	13.00	1	175.8	2285.4
22	SEMI PRV-437	SEMI PRV-437 L1	Patient Room (Hospital)	1.00	131.10	13.00	1	131.1	1704.3
In Zone:	**STAIR-132**								
1	STAIR-132	STAIR-132	Stair - Active Traffic	1.00	200.00	26.50	1	200.0	5300.0
In Zone:	**STAIR-157**								
1	STAIR-157	STAIR-157	Stair - Active Traffic	1.00	200.00	26.50	1	200.0	5300.0
In Zone:	**STAIR-187**								
1	STAIR-187	STAIR-187	Stair - Active Traffic	1.00	229.00	26.50	1	229.0	6068.5
In Zone:	**STAIR-132**								

1	STAIR-193	STAIR-193	Stair - Active Traffic	1.00	200.00	26.50	1	200.0	5300.0	
In Zone:	**UNCONDITIONED**									
1	SUPPLY-136A	SUPPLY-136A	Electrical Mechanical Equipment Room - General	1.00	31.00	13.60	1	31.0	421.6	
2	164 KITCHEN S	164 KITCHEN STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	136.00	13.60	1	136.0	1849.6	
3	167A SECURE S	167A SECURE STORAGE	Storage & Warehouse - Bulky Active Storage	1.00	29.00	13.60	1	29.0	394.4	
4	164 KITCHEN H	164 KITCHEN HALL	Corridor	1.00	67.00	13.60	1	67.0	911.2	
5	188 FIRE RISER	188 FIRE RISER	Storage & Warehouse - Bulky Active Storage	1.00	52.00	13.60	1	52.0	707.2	
6	193A/193B ELE	193A/193B ELECTRICAL	Electrical Mechanical Equipment Room - General	1.00	24.00	13.60	2	48.0	652.8	
7	193B CL. LINEN	193B CL. LINEN	Storage & Warehouse - Bulky Active Storage	1.00	24.00	13.60	1	24.0	326.4	
8	193C COMM	193C COMM	Electrical Mechanical Equipment Room - General	1.00	24.00	13.60	1	24.0	326.4	
9	248C COMM	248C/258C COMM	Electrical Mechanical Equipment Room - General	1.00	24.00	13.60	2	48.0	652.8	
10	248D/258A/258I	248D/258A/258D ELECTRICAL	Electrical Mechanical Equipment Room - General	1.00	24.00	13.60	3	72.0	979.2	
11	258B CL. LINEN	258B CL. LINEN	Storage & Warehouse - Bulky Active Storage	1.00	24.00	13.60	1	24.0	326.4	
12	261A SHOWER	261A ASSISTED SHOWER	Toilet and Washroom	1.00	192.00	13.60	2	384.0	5222.4	
13	182 WATER HE/	182 WATER HEATER	Electrical Mechanical Equipment Room - General	1.00	144.00	13.60	1	144.0	1958.4	
14	250 FIRE RISER	250 FIRE RISER	Storage & Warehouse - Bulky Active Storage	1.00	52.00	13.00	1	52.0	676.0	

Lighting

No	Type	Category	No. of Luminaires	Watts per Luminaire	Power [W]	Control Type	
In Zone:	**FCU-1.1**						
In Space:	**141 SPEECH THERAPY**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**142 COUNSELING**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**143 UNIT MANG.**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**144 HALL.**						
1	LED	General Lighting	2	18	35	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**145 ADMI. OFFICE**						

1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**146 PLAN OFFICE**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**FCU-1.2**						
In Space:	**139 BEAUTY SALON**						
1	LED	General Lighting	2	18	35	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	2	7	14	None	☐
In Space:	**140 SALON TLT**						
1	LED	General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**FCU-1.3**						
In Space:	**131 OCUU. THERAPY**						
1	LED	General Lighting	2	18	35	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**FCU-1.4**						
In Space:	**124 ADMIN OFFICE**						

1	LED		General Lighting	2	18	35	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**125 RECEPTION**							
1	LED		General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	2	16	32	None	☐
In Space:	**126 MEETING ROOM**							
1	LED		General Lighting	5	18	88	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**128 PUB TLT**							
1	LED		General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**129 PUB TLT**							
1	LED		General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**127 MAIL RM.**							
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Zone:	**FCU-1.5**							
In Space:	**121 VESTIBUL**							

1	LED		General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**122 LOBBY**							
1	LED		General Lighting	1	21	21	Occupant Sensor (50%)-Occupant Sensor (50%) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	1	1	1	None	☐
3	LED		General Lighting	11	18	193	None	☐
4	LED		General Lighting	2	36	73	None	☐
In Space:	**123 ELEV. LOBBY**							
1	LED		General Lighting	12	18	210	Occupant Sensor (50%)-Occupant Sensor (50%) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	2	15	30	None	☐
3	LED		General Lighting	1	1	1	None	☐
4	LED		General Lighting	1	21	21	None	☐
In Zone:	**FCU-1.6**							
In Space:	**130 PHYSCIAL THERAPY**							
1	LED		General Lighting	8	18	140	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
In Zone:	**FCU-1.7**							
In Space:	**130 PHYSCIAL THERAPY**							
1	LED		General Lighting	9	18	158	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED		General Lighting	1	1	1	None	☐
In Zone:	**FCU-1.8**							
In Space:	**152B CORRIDOR**							

1	LED	General Lighting	10	18	175	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED	General Lighting	1	1	1	None	☐
3	LED	General Lighting	1	1	1	None	☐
In Zone:	**FCU-1.9**						
In Space:	**133 PHYSCIAL THERAPY**						
1	LED	General Lighting	3	18	53	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	1	1	1	None	☐
In Space:	**134 PT. RECEPTION**						
1	LED	General Lighting	4	18	70	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**FCU-1.10**						
In Space:	**135 INDIVIDUAL TRET.**						
1	LED	General Lighting	3	18	53	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**137 TRAT. ROOM**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**138 EXAM ROOM**						

1	LED	General Lighting	3	18	53	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**136 HALL**						
1	LED	General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Zone:	**FCU-1.11**						
In Space:	**154 CONFERENCE ROOM**						
1	LED	General Lighting	8	18	140	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	1	32	32	None	☐
In Space:	**153 P.T STORAGE**						
1	LED	General Lighting	4	20	80	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Zone:	**FCU-1.12**						
In Space:	**147 ACC. OFFICE**						

1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**148 BOOKING OFFICE**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**151 COPY ROOM**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**150 WORK ROOM**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**149 HALL**						

1	LED	General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Zone:	**FCU-1.13**						
In Space:	**155 MEDICAL RECORDS**						
1	LED	General Lighting	3	20	60	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**156 RESIDENT STO.**						
1	LED	General Lighting	7	20	140	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**158 FACILITY STO.**						
1	LED	General Lighting	3	20	60	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**162 CENTRAL SUPPLY**						
1	LED	General Lighting	5	20	100	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**163 MAIN. EQUI/SPLY**						

1	LED		General Lighting	5	20	100	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Space:	**152 CORRIDOR**						
1	LED		General Lighting	10	18	175	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
2	LED		General Lighting	1	1	1	None
In Zone:	**FCU-1.14**						
In Space:	**159 STAFF LOUNGH**						
1	LED		General Lighting	5	15	75	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Space:	**160 STAFF TLT**						
1	LED		General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Space:	**161 STAFF TLT**						
1	LED		General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Zone:	**FCU-1.15**						
In Space:	**165 DINING**						

1	LED		General Lighting	11	18	193	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	33	33	None	☐
3	LED		General Lighting	2	13	26	None	☐
In Zone:	**FCU-1.16**							
In Space:	**175 STORAGE**							
1	LED		General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**178 STAFFT TLT**							
1	LED		General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**179 STAFFT TLT**							
1	LED		General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**170 HOUSE. OFFICE**							
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**171 MAINT. OFFICE**							

1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Zone:	**FCU-1.17**						
In Space:	**185 LAUNDRY**						
1	LED		General Lighting	5	20	100	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
In Space:	**186 HOLDING AREA**						
1	LED		General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
In Space:	**172 SERVICE CORRIDOR**						
1	LED		General Lighting	9	18	158	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
2	LED		General Lighting	2	1	2	None
In Space:	**183 SORTING /FOLDING**						
1	LED		General Lighting	3	20	60	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off

	In Space:	**184 LAUNDRY**						
1	LED		General Lighting	3	20	60	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	36	36	None	☐
	In Space:	**177 CENTRAL CLEAN**						
1	LED		General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**173 SOLID HOLDING**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**174 WASTE MANAGEMENT**						
1	LED		General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Zone:	**FCU-1.18**							
	In Space:	**187B CORRIDOR**						
1	LED		General Lighting	10	18	175	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	1	1	1	None	☐

	In Space:	**187A CORRIDOR**					
1	LED	General Lighting	10	18	175	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED	General Lighting	1	33	33	None	☐
3	LED	General Lighting	2	1	2	None	☐
	In Space:	**189 CLEAN UTILITY**					
1	LED	General Lighting	3	20	60	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**190 SOLIED UTILITY**					
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**191 SECURE STORAGE**					
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**192 DON OFFICE**					
1	LED	General Lighting	3	18	53	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐

In Zone: **FCU-1.19**

	In Space:	**187C CORRIDOR**						
1	LED		General Lighting	13	18	228	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	1	33	33	None	☐
3	LED		General Lighting	2	1	2	None	☐
In Zone:	**FCU-1.20**							
	In Space:	**194 NURSE STATION**						
1	LED		General Lighting	2	18	35	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	2	16	32	None	☐
	In Space:	**197 STAFF TLT**						
1	LED		General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**196 MED RM**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**195 NOURISH**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**FCU-1.21**							
	In Space:	**198 ACTIVITY ROOM**						

1	LED		General Lighting	1	13	13	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
2	LED		General Lighting	5	18	88	None
In Zone:	**FCU-1.22A**						
In Space:	**164 COM. KITCHEN**						
1	LED		General Lighting	5	20	100	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
2	LED		General Lighting	1	1	1	None
In Space:	**167 DIETARY OFFICE**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Zone:	**FCU-1.22B**						
In Space:	**164 COM. KITCHEN**						
1	LED		General Lighting	8	20	160	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off

2	LED	General Lighting	1	1	1	None	☐
In Space:	**164B DRY STORAGE**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**FCU-2.1**						
In Space:	**244 CAREPLAN MEETING**						
1	LED	General Lighting	5	18	88	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**245 ADON OFFICE**						
1	LED	General Lighting	3	18	53	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**FCU-2.2**						
In Space:	**249 CORRIDOR**						
1	LED	General Lighting	5	18	88	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED	General Lighting	1	33	33	None	☐
In Space:	**249B CORRIDOR**						

1	LED	General Lighting	13	18	228	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED	General Lighting	2	1	2	None	☐
In Space:	**243 ELEV LOBBY**						
1	LED	General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED	General Lighting	1	21	21	None	☐
In Zone:	**FCU-2.3**						
In Space:	**249A CORRIDOR**						
1	LED	General Lighting	11	18	193	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED	General Lighting	1	33	33	None	☐
3	LED	General Lighting	1	1	1	None	☐
In Zone:	**FCU-2.4**						
In Space:	**252 ACTIVITY ROOM**						
1	LED	General Lighting	2	13	26	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	1	33	33	None	☐
3	LED	General Lighting	1	18	18	None	☐
In Zone:	**FCU-2.5**						
In Space:	**255 SERVICE STAGING**						
1	LED	General Lighting	8	20	160	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**254 WARMIMG KITCHEN**						

1	LED		General Lighting	8	20	160	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Zone:	**FCU-2.6**							
In Space:	**253 DINING**							
1	LED		General Lighting	1	33	33	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	10	18	175	None	☐
3	LED		General Lighting	5	13	65	None	☐
In Space:	**WALKING AIDS**							
1	LED		General Lighting	1	33	33	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**FCU-2.7**							
In Space:	**262 CORRIDOR**							
1	LED		General Lighting	9	18	158	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	2	1	2	None	☐
In Space:	**262A CORRIDOR**							

1	LED	General Lighting	9	18	158	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED	General Lighting	1	1	1	None	☐
In Space:	**259 CLEAN UTILITY**						
1	LED	General Lighting	3	20	60	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**260 SOLIED UTILITY**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**ASSISTED TLT 261B**						
1	LED	General Lighting	1	20	20	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**FCU-2.8**						
In Space:	**264 NURSE STATION**						
1	LED	General Lighting	2	18	35	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	2	16	32	None	☐
In Space:	**267 STAFF TLT**						

1	LED		General Lighting	1	1	1	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**266 MED RM**							
1	LED		General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**265 NOURISH**							
1	LED		General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**FCU-2.9**							
In Space:	**262B CORRIDOR**							
1	LED		General Lighting	13	18	228	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	1	33	33	None	☐
3	LED		General Lighting	2	1	2	None	☐
In Zone:	**FCU-2.10**							
In Space:	**268 ACTIVITY ROOM**							
1	LED		General Lighting	2	13	26	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐

2	LED	General Lighting	5	18	88	None	☐
In Zone:	**AC-1.1**						
In Space:	**180A MAIN ELEC.**						
1	LED	General Lighting	4	20	80	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**AC-1.2**						
In Space:	**180B MAIN ELEC.**						
1	LED	General Lighting	3	20	60	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**AC-1.3**						
In Space:	**176 TELE-COM**						
1	LED	General Lighting	2	20	40	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**AC-1.4**						
In Space:	**169 ELEV. EQUIP**						
1	LED	General Lighting	2	20	40	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Zone:	**AC-1.5**						
In Space:	**199 ELEC EQUIP.**						

1	LED		General Lighting	4	20	80	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Zone:	**AC-2.1**						
In Space:	**257 ELEC ROOM**						
1	LED		General Lighting	2	20	40	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Zone:	**AC-2.2**						
In Space:	**256 ELEC ROOM**						
1	LED		General Lighting	2	20	40	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Zone:	**SEMI PRV-L1-AREA458**						
In Space:	**SEMI PRV**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)
2	LED		General Lighting	1	15	15	None
In Zone:	**SEMI PRV-L1-AREA458**						
In Space:	**SEMI PRV**						

1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L1-AREA562**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L1-AREA586**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L1-AREA437**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L1-AREA476**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L1-AREA516**						

In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA458**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA458**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%) Manual (Local Control)-Manual (Local Control)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA458**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA478**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐

In Zone:	**SEMI PRV-L2-AREA610**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA465**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA451**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA473**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA521**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐

2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA564**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA476**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA516**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA588**						
In Space:	**SEMI PRV**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone:	**SEMI PRV-L2-AREA437**						
In Space:	**SEMI PRV**						

1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone: PRV-L2-AREA470 **In Space: PRIVATE**							
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone: PRV-L2-AREA480 **In Space: PRIVATE**							
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone: PRV-L2-AREA395 **In Space: PRIVATE**							
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	1	15	15	None	☐
In Zone: MAU-1 **In Space: 141 SPEECH THERAPY**							

1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**142 COUNSELING**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**143 UNIT MANG.**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**144 HALL.**						
1	LED	General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**145 ADMI. OFFICE**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**146 PLAN OFFICE**						

1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**139 BEAUTY SALON**						
1	LED	General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	1	7	7	None	☐
In Space:	**140 SALON TLT**						
1	LED	General Lighting	1	1	1	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**131 OCUU. THERAPY**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**124 ADMIN OFFICE**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**125 RECEPTION**						
1	LED	General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	1	16	16	None	☐

	In Space:	**126 MEETING ROOM**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**128 PUB TLT**						
1	LED		General Lighting	1	1	1	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**129 PUB TLT**						
1	LED		General Lighting	1	1	1	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**127 MAIL RM.**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**121 VESTIBUL**						
1	LED		General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**122 LOBBY**						
1	LED		General Lighting	1	21	21	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	18	18	None	☐
3	LED		General Lighting	1	36	36	None	☐
	In Space:	**123 ELEV. LOBBY**						

1	LED	General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED	General Lighting	1	1	1	None	☐
In Space:	**130 PHYSCIAL THERAPY**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
In Space:	**130 PHYSCIAL THERAPY**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Light Reduction (30%-70%)-Light Reduction (30%-70%)	☐
In Space:	**152B CORRIDOR**						
1	LED	General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**133 PHYSCIAL THERAPY**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**134 PT. RECEPTION**						
1	LED	General Lighting	1	18	18	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**135 INDIVIDUAL TRET.**						

1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**137 TRAT. ROOM**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**138 EXAM ROOM**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**136 HALL**						
1	LED	General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**154 CONFERENCE ROOM**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	1	32	32	None	☐

	In Space:	**153 P.T STORAGE**					
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**244 CAREPLAN MEETING**					
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**245 ADON OFFICE**					
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**249 CORRIDOR**					
1	LED	General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**249B CORRIDOR**					
1	LED	General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**243 ELEV LOBBY**					

1	LED		General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	1	21	21	None	☐
In Space:	**SEMI PRV-458**							
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**SEMI PRV-478**							
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**SEMI PRV-610**							
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**PRIVATE-395**							

1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**PRIVATE-480**							
1	LED		General Lighting	1	15	15	Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Occupant Sensor (50%)-Occupant Sensor (50%) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Manual (Local Control)-Manual (Local Control)	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**PRIVATE-470**							
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Zone:	**MAU-2**							
In Space:	**147 ACC. OFFICE**							
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**148 BOOKING OFFICE**							

1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**151 COPY ROOM**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**150 WORK ROOM**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**149 HALL**						
1	LED	General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**155 MEDICAL RECORDS**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**156 RESIDENT STO.**						

1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**158 FACILITY STO.**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**162 CENTRAL SUPPLY**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**163 MAIN. EQUI/SPLY**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**159 STAFF LOUNGH**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐

	In Space:	**160 STAFF TLT**						
1	LED		General Lighting	1	1	1	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**161 STAFF TLT**						
1	LED		General Lighting	1	1	1	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**165 DINING**						
1	LED		General Lighting	2	18	35	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	33	33	None	☐
3	LED		General Lighting	1	13	13	None	☐
	In Space:	**164 COM. KITCHEN**						
1	LED		General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	1	1	None	☐
	In Space:	**167 DIETARY OFFICE**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**164 COM. KITCHEN**						

1	LED		General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Space:	**164B DRY STORAGE**						
1	LED		General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
In Space:	**249A CORRIDOR**						
1	LED		General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
2	LED		General Lighting	1	1	1	None
In Space:	**252 ACTIVITY ROOM**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Space:	**SEMI PRV-458**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
2	LED		General Lighting	1	15	15	None

	In Space:	**SEMI PRV-478**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-473**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-451**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-465**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**152 CORRIDOR**						

1	LED		General Lighting	2	18	35	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
2	LED		General Lighting	1	1	1	None
In Zone:	**MAU-3**						
In Space:	**175 STORAGE**						
1	LED		General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
In Space:	**178 STAFFT TLT**						
1	LED		General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
In Space:	**179 STAFFT TLT**						
1	LED		General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
In Space:	**170 HOUSE. OFFICE**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Space:	**171 MAINT. OFFICE**						

1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**185 LAUNDRY**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**186 HOLDING AREA**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**172 SERVICE CORRIDOR**						
1	LED	General Lighting	2	18	35	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**183 SORTING /FOLDING**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**184 LAUNDRY**						

1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**177 CENTRAL CLEAN**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**173 SOLID HOLDING**						
1	LED	General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**174 WASTE MANAGEMENT**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**187B CORRIDOR**						
1	LED	General Lighting	2	18	35	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**187A CORRIDOR**						

1	LED	General Lighting	2	18	35	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**189 CLEAN UTILITY**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**190 SOLIED UTILITY**						
1	LED	General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**191 SECURE STORAGE**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**192 DON OFFICE**						
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**255 SERVICE STAGING**						

1	LED		General Lighting	2	20	40	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**254 WARMIMG KITCHEN**							
1	LED		General Lighting	2	20	40	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**253 DINING**							
1	LED		General Lighting	1	33	33	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	2	18	35	None	☐
3	LED		General Lighting	1	13	13	None	☐
In Space:	**WALKING AIDS**							
1	LED		General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**262 CORRIDOR**							
1	LED		General Lighting	2	18	35	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**262A CORRIDOR**							

1	LED	General Lighting	2	18	35	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**259 CLEAN UTILITY**						
1	LED	General Lighting	1	20	20	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**260 SOLIED UTILITY**						
1	LED	General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**ASSISTED TLT 261B**						
1	LED	General Lighting	1	20	20	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**SEMI PRV-458**						
1	LED	General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED	General Lighting	1	15	15	None	☐
In Space:	**SEMI PRV-458**						

1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-562**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-458**						
1	LED		General Lighting	1	15	15	Occupant Sensor (50%)-Occupant Sensor (50%) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF Manual (Local Control)-Manual (Local Control)	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-521**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-564**						

1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Zone:	**MAU-4**							
In Space:	**187C CORRIDOR**							
1	LED		General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	1	33	33	None	☐
3	LED		General Lighting	1	1	1	None	☐
In Space:	**194 NURSE STATION**							
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	16	16	None	☐
In Space:	**197 STAFF TLT**							
1	LED		General Lighting	1	1	1	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**196 MED RM**							

1	LED		General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**195 NOURISH**							
1	LED		General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**198 ACTIVITY ROOM**							
1	LED		General Lighting	1	13	13	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	18	18	None	☐
In Space:	**264 NURSE STATION**							
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	16	16	None	☐
In Space:	**267 STAFF TLT**							

1	LED		General Lighting	1	1	1	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**266 MED RM**						
1	LED		General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**265 NOURISH**						
1	LED		General Lighting	1	1	1	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**262B CORRIDOR**						
1	LED		General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	1	33	33	None	☐
3	LED		General Lighting	1	1	1	None	☐
	In Space:	**268 ACTIVITY ROOM**						
1	LED		General Lighting	1	13	13	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	18	18	None	☐
	In Space:	**SEMI PRV-476**						

1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-458**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-516**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-586**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
	In Space:	**SEMI PRV-437**						

1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**SEMI PRV-476**							
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**SEMI PRV-458**							
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**SEMI PRV-516**							
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**SEMI PRV-586**							

1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Space:	**SEMI PRV-437**							
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	15	15	None	☐
In Zone:	**STAIR-132**							
In Space:	**STAIR-132**							
1	LED		General Lighting	4	36	144	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	1	1	None	☐
In Zone:	**STAIR-157**							
In Space:	**STAIR-157**							
1	LED		General Lighting	4	33	130	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	1	1	None	☐
In Zone:	**STAIR-187**							
In Space:	**STAIR-187**							
1	LED		General Lighting	4	33	130	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	1	1	None	☐
In Zone:	**STAIR-132**							
In Space:	**STAIR-193**							

1	LED		General Lighting	4	33	130	Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
2	LED		General Lighting	1	1	1	None	☐
In Zone:	**UNCONDITIONED**							
In Space:	**SUPPLY-136A**							
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
In Space:	**164 KITCHEN STORAGE**							
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**167A SECURE STORAGEE**							
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
In Space:	**164 KITCHEN HALL**							
1	LED		General Lighting	1	18	18	Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
2	LED		General Lighting	1	1	1	None	☐
In Space:	**188 FIRE RISER**							

1	LED		General Lighting	1	36	36	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
In Space:	**193A/193B ELEC**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Space:	**193B CL. LINEN**						
1	LED		General Lighting	1	15	15	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off
In Space:	**193C COMM**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF
In Space:	**248C COMM**						
1	LED		General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF

	In Space:	**248D/258A/258D ELEC**					
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**258B CL. LINEN**					
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐
	In Space:	**261A SHOWER**					
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**182 WATER HEATER**					
1	LED	General Lighting	1	18	18	Manual (Local Control)-Manual (Local Control) Occupancy Sensor - Manual ON only-Occupancy Sensor - Manual ON only Occupant Sensor (50%)-Occupant Sensor (50%) Occupant Sensor Auto Full OFF-Occupant Sensor Auto Full OFF	☐
	In Space:	**250 FIRE RISER**					

1	LED	General Lighting	1	36	36	Manual (Local Control)-Manual (Local Control) Occupant Sensor Auto OFF (Full or Partial)-Occupant Sensor Auto OFF (Full or Partial) Time-Switch: Auto Full Off or Scheduled Off-Time-Switch: Auto Full Off or Scheduled Off	☐

Walls (Walls will be rotated clockwise by building rotation value)

No	Description	Type	Width [ft]	H (Effec) [ft]	Multiplier	Area [sf]	Orientation	Conductance [Btu/h.sf.F]	Heat Capacity [Btu/sf.F]	Dens. [lb/cf]	R-Value [h.sf.F/Bt
In Zone:	**FCU-1.1**										
1	NORTH WALL	EXT WALL	27.00	13.60	1	367.2	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.2**										
1	NORTH WALL	EXT WALL	23.00	13.60	1	312.8	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.4**										
1	WEST WALL	EXT WALL	30.90	13.60	1	420.2	West	0.0782	0.522	9.89	12.8
2	NORTH WALL	EXT WALL	7.00	13.60	1	95.2	North	0.0782	0.522	9.89	12.8
3	EAST WALL	EXT WALL	12.50	13.60	1	170.0	East	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.5**										
1	WEST WALL	EXT WALL	26.30	13.60	1	357.7	West	0.0782	0.522	9.89	12.8
2	EAST WALL	EXT WALL	28.50	26.60	1	758.1	East	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.6**										
1	EAST WALL	EXT WALL	28.50	13.60	1	387.6	East	0.0782	0.522	9.89	12.8
2	SOUTH WALL	EXT WALL	4.50	13.60	1	61.2	South	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.7**										
1	EAST WALL	EXT WALL	28.50	13.60	1	387.6	East	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.9**										
1	EAST WALL	EXT WALL	4.50	13.60	1	61.2	East	0.0782	0.522	9.89	12.8
2	SOUTH WALL	EXT WALL	30.30	13.60	1	412.1	South	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.10**										
1	WEST WALL	EXT WALL	4.50	13.60	1	61.2	West	0.0782	0.522	9.89	12.8
2	SOUTH WALL	EXT WALL	13.50	13.60	1	183.6	South	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.11**										
1	SOUTH WALL	EXT WALL	35.90	13.60	1	488.2	South	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.12**										
1	NORTH WALL	EXT WALL	25.00	13.60	1	340.0	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.13**										
1	SOUTH WALL	EXT WALL	103.20	13.60	1	1403.5	South	0.0782	0.522	9.89	12.8
2	WEST WALL	EXT WALL	28.20	13.60	1	383.5	West	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.14**										
1	NORTH WALL	EXT WALL	30.00	13.60	1	408.0	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.15**										
1	EAST WALL	EXT WALL	30.90	13.60	1	420.2	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.16**										
1	WEST WALL	EXT WALL	14.50	13.60	1	197.2	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.17**										
1	WEST WALL	EXT WALL	51.40	13.60	1	699.0	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.21**										
1	WEST WALL	EXT WALL	28.30	13.60	1	384.9	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.22A**										
1	WEST WALL	EXT WALL	24.20	13.60	1	329.1	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-1.22B**										

1	WEST WALL	EXT WALL	24.20	13.60	1	329.1	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-2.2**										
1	WEST WALL	EXT WALL	15.40	13.00	1	200.2	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-2.5**										
1	WEST WALL	EXT WALL	54.30	13.00	1	705.9	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-2.6**										
1	EAST WALL	EXT WALL	54.30	13.00	1	705.9	North	0.0782	0.522	9.89	12.8
In Zone:	**FCU-2.10**										
1	WEST WALL	EXT WALL	37.10	10.00	1	371.0	North	0.0782	0.522	9.89	12.8
In Zone:	**AC-1.1**										
1	WEST WALL	EXT WALL	17.70	13.60	1	240.7	North	0.0782	0.522	9.89	12.8
In Zone:	**AC-1.3**										
1	WEST WALL	EXT WALL	17.70	13.60	1	240.7	North	0.0782	0.522	9.89	12.8
In Zone:	**AC-1.5**										
1	WEST WALL	EXT WALL	12.40	13.60	1	168.6	North	0.0782	0.522	9.89	12.8
In Zone:	**AC-2.1**										
1	WEST WALL	EXT WALL	10.00	13.60	1	136.0	North	0.0782	0.522	9.89	12.8
In Zone:	**AC-2.2**										
1	WEST WALL	EXT WALL	11.30	13.60	1	153.7	North	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L1-AREA458**										
1	EAST WALL	EXT WALL	20.80	13.60	1	282.9	East	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L1-AREA458**										
1	EAST WALL	EXT WALL	20.80	13.60	1	282.9	East	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L1-AREA562**										
1	NORTH WALL	EXT WALL	24.70	13.60	1	335.9	North	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L1-AREA586**										
1	EAST WALL	EXT WALL	28.70	13.60	1	390.3	East	0.0782	0.522	9.89	12.8
2	NORTH WALL	EXT WALL	22.60	13.60	1	307.4	North	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L1-AREA437**										
1	EAST WALL	EXT WALL	20.90	13.60	1	284.2	East	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L1-AREA476**										
1	NORTH WALL	EXT WALL	21.60	13.60	1	293.8	North	0.0782	0.522	9.89	12.8
2	EAST WALL	EXT WALL	4.50	13.60	1	61.2	East	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L1-AREA516**										
1	NORTH WALL	EXT WALL	20.90	13.60	1	284.2	North	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA458**										
1	WEST WALL	EXT WALL	20.80	13.60	1	282.9	West	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA458**										
1	WEST WALL	EXT WALL	20.80	13.60	1	282.9	West	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA458**										
1	WEST WALL	EXT WALL	20.80	13.00	1	270.4	West	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA478**										
1	WEST WALL	EXT WALL	4.50	13.00	1	58.5	West	0.0782	0.522	9.89	12.8
2	SOUTH WALL	EXT WALL	20.80	13.00	1	270.4	South	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA610**										
1	EAST WALL	EXT WALL	29.30	13.00	1	380.9	East	0.0782	0.522	9.89	12.8
2	SOUTH WALL	EXT WALL	23.50	13.00	1	305.5	South	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA465**										
1	WEST WALL	EXT WALL	21.50	13.00	1	279.5	West	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA451**										

1	WEST WALL	EXT WALL	20.70	13.00	1	269.1	West	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA473**										
1	WEST WALL	EXT WALL	22.30	13.00	1	289.9	West	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA521**										
1	WEST WALL	EXT WALL	23.70	13.00	1	308.1	West	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA564**										
1	NORTH WALL	EXT WALL	24.80	13.00	1	322.4	North	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA476**										
1	NORTH WALL	EXT WALL	21.60	13.00	1	280.8	North	0.0782	0.522	9.89	12.8
2	EAST WALL	EXT WALL	4.50	13.00	1	58.5	East	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA516**										
1	NORTH WALL	EXT WALL	22.80	13.00	1	296.4	North	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA588**										
1	NORTH WALL	EXT WALL	22.60	13.00	1	293.8	North	0.0782	0.522	9.89	12.8
2	EAST WALL	EXT WALL	28.80	13.00	1	374.4	East	0.0782	0.522	9.89	12.8
In Zone:	**SEMI PRV-L2-AREA437**										
1	EAST WALL	EXT WALL	20.80	13.00	1	270.4	East	0.0782	0.522	9.89	12.8
In Zone:	**PRV-L2-AREA470**										
1	EAST WALL	EXT WALL	29.30	13.00	1	380.9	East	0.0782	0.522	9.89	12.8
2	NORTH WALL	EXT WALL	7.00	13.00	1	91.0	North	0.0782	0.522	9.89	12.8
In Zone:	**PRV-L2-AREA480**										
1	EAST WALL	EXT WALL	23.60	13.00	1	306.8	East	0.0782	0.522	9.89	12.8
2	SOUTH WALL	EXT WALL	7.00	13.00	1	91.0	South	0.0782	0.522	9.89	12.8
In Zone:	**PRV-L2-AREA395**										
1	EAST WALL	EXT WALL	14.90	13.00	1	193.7	East	0.0782	0.522	9.89	12.8
In Zone:	**STAIR-132**										
1	SOUTH WALL	EXT WALL	9.50	26.50	1	251.8	South	0.0782	0.522	9.89	12.8
In Zone:	**STAIR-157**										
1	SOUTH WALL	EXT WALL	8.80	26.50	1	233.2	South	0.0782	0.522	9.89	12.8
In Zone:	**STAIR-187**										
1	WEST WALL	EXT WALL	25.50	26.50	1	675.8	West	0.0782	0.522	9.89	12.8
In Zone:	**STAIR-132**										
1	NORTH WALL	EXT WALL	9.50	26.50	1	251.8	North	0.0782	0.522	9.89	12.8
In Zone:	**UNCONDITIONED**										
1	136A	EXT WALL	5.50	13.60	1	74.8	North	0.0782	0.522	9.89	12.8
2	164 KITCHEN STORAGE	EXT WALL	20.10	13.60	1	273.4	North	0.0782	0.522	9.89	12.8
3	182	EXT WALL	7.40	13.60	1	100.6	North	0.0782	0.522	9.89	12.8
4	188	EXT WALL	7.00	13.60	1	95.2	North	0.0782	0.522	9.89	12.8
5	250	EXT WALL	7.00	13.00	1	91.0	North	0.0782	0.522	9.89	12.8

Windows (Windows will be rotated clockwise by building rotation value)

No	Description	Orientation	Shaded	U [Btu/hr sf F]	SHGC	Vis.Tra	W [ft]	H (Effec) [ft]	Multiplier	Total Area [sf]
In Zone: FCU-1.1										
In Wall: NORTH WALL										
1	WINDOW	North	No	0.6500	0.25	0.76	6.00	4.41	2	52.9
In Zone: FCU-1.10										
In Wall: SOUTH WALL										
1	WINDOW	South	No	0.5000	0.25	0.76	4.50	6.00	2	54.0
In Zone: FCU-1.11										
In Wall: SOUTH WALL										
1	WINDOW	South	No	0.5000	0.25	0.76	4.50	6.00	2	54.0
In Zone: FCU-1.12										
In Wall: NORTH WALL										
1	WINDOW	North	No	0.5000	0.25	0.76	4.50	6.00	2	54.0
In Zone: FCU-1.13										
In Wall: SOUTH WALL										
2	WINDOW	South	No	0.5000	0.25	0.76	4.50	6.00	5	135.0
In Wall: WEST WALL										
1	WINDOW	West	No	0.5000	0.25	0.76	4.50	6.00	5	135.0
In Zone: FCU-1.14										
In Wall: NORTH WALL										
1	WINDOW	North	No	0.5000	0.25	0.76	4.50	6.00	1	27.0
2	GLASS DOOR	North	No	0.8300	0.25	0.76	6.00	7.00	1	42.0
In Zone: FCU-1.15										
In Wall: EAST WALL										
1	GLASS DOOR	North	No	0.8300	0.25	0.76	6.00	7.00	3	126.0
In Zone: FCU-1.2										
In Wall: NORTH WALL										
1	WINDOW	North	No	0.6500	0.25	0.76	6.00	4.41	2	52.9
In Zone: FCU-1.21										
In Wall: WEST WALL										
1	WINDOW	North	No	0.5000	0.25	0.76	4.50	6.00	2	54.0
2	GLASS DOOR	North	No	0.8300	0.25	0.76	6.00	7.00	2	84.0
In Zone: FCU-1.4										
In Wall: EAST WALL										
1	WINDOW	East	No	0.5000	0.25	0.76	4.50	6.00	1	27.0
In Wall: WEST WALL										
1	WINDOW	West	No	0.5000	0.25	0.76	4.50	6.00	1	27.0
In Zone: FCU-1.5										
In Wall: EAST WALL										
1	WINDOW	East	No	0.5000	0.25	0.76	4.50	6.00	1	27.0
In Wall: WEST WALL										
1	WINDOW	West	No	0.5000	0.25	0.76	4.50	6.00	1	27.0
In Zone: FCU-1.6										
In Wall: EAST WALL										
1	WINDOW	East	No	0.5000	0.25	0.76	4.50	6.00	3	81.0
In Zone: FCU-1.7										
In Wall: EAST WALL										
1	WINDOW	East	No	0.5000	0.25	0.76	4.50	6.00	3	81.0
In Zone: FCU-1.9										
In Wall: SOUTH WALL										
1	WINDOW	South	No	0.5000	0.25	0.76	4.50	6.00	2	54.0

In Zone:	**FCU-2.10**									
In Wall:	**WEST WALL**									
1	WINDOW	North	No	0.5000	0.25	0.76	4.50	6.00	3	81.0
In Zone:	**FCU-2.2**									
In Wall:	**WEST WALL**									
1	WINDOW	North	No	0.5000	0.25	0.76	12.00	6.00	1	72.0
In Zone:	**FCU-2.6**									
In Wall:	**EAST WALL**									
1	WINDOW	North	No	1.2500	0.82	0.76	4.50	6.00	6	162.0
In Zone:	**PRV-L2-AREA395**									
In Wall:	**EAST WALL**									
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**PRV-L2-AREA470**									
In Wall:	**EAST WALL**									
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**PRV-L2-AREA480**									
In Wall:	**EAST WALL**									
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L1-AREA437**									
In Wall:	**EAST WALL**									
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L1-AREA458**									
In Wall:	**EAST WALL**									
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L1-AREA476**									
In Wall:	**NORTH WALL**									
1	WINDOW	North	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L1-AREA516**									
In Wall:	**NORTH WALL**									
1	WINDOW	North	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L1-AREA562**									
In Wall:	**NORTH WALL**									
1	WINDOW	North	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L1-AREA586**									
In Wall:	**EAST WALL**									
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA437**									
In Wall:	**EAST WALL**									
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA451**									
In Wall:	**WEST WALL**									
1	WINDOW	West	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA458**									
In Wall:	**WEST WALL**									
1	WINDOW	West	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
1	WINDOW	West	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
1	WINDOW	West	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA465**									
In Wall:	**WEST WALL**									
1	WINDOW	West	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA473**									
In Wall:	**WEST WALL**									
1	WINDOW	West	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA476**									
In Wall:	**NORTH WALL**									
1	WINDOW	North	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA478**									
In Wall:	**SOUTH WALL**									
1	WINDOW	South	No	0.6500	0.25	0.76	4.50	6.00	2	54.0

In Zone:	**SEMI PRV-L2-AREA516**									
In Wall:	**NORTH WALL**									
1	WINDOW	North	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA521**									
In Wall:	**WEST WALL**									
1	WINDOW	West	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA564**									
In Wall:	**NORTH WALL**									
1	WINDOW	North	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA588**									
In Wall:	**EAST WALL**									
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0
In Zone:	**SEMI PRV-L2-AREA610**									
In Wall:	**EAST WALL**									
1	WINDOW	East	No	0.6500	0.25	0.76	4.50	6.00	2	54.0

Doors

No	Description	Type	Shade?	Width [ft]	H (Effec) [ft]	Multiplier	Area [sf]	Cond. [Btu/h.sf.F]	Dens. [lb/cf]	Ht Cap. [Btu/sf.F]	R [h.sf.F/Btu]	
In Zone:	**FCU-1.1**											
	In Wall:	**NORTH WALL**										
1	DOOR	DOOR	No	3.00	7.00	1	21.0	0.6100	0.00	0.00	1.64	
In Zone:	**FCU-1.9**											
	In Wall:	**SOUTH WALL**										
1	DOOR	DOOR	No	4.00	7.00	1	28.0	0.6100	0.00	0.00	1.64	
In Zone:	**FCU-1.13**											
	In Wall:	**SOUTH WALL**										
1	DOOR	DOOR	No	4.00	7.00	1	28.0	0.6100	0.00	0.00	1.64	
	In Wall:	**WEST WALL**										
1	DOOR	DOOR	No	4.00	7.00	1	28.0	0.6100	0.00	0.00	1.64	
In Zone:	**FCU-1.17**											
	In Wall:	**WEST WALL**										
1	DOOR	DOOR	No	7.00	7.00	1	49.0	0.6100	0.00	0.00	1.64	
2	DOOR	DOOR	No	4.00	7.00	2	28.0	0.6100	0.00	0.00	1.64	
In Zone:	**FCU-1.22B**											
	In Wall:	**WEST WALL**										
1	DOOR	DOOR	No	4.00	7.00	1	28.0	0.6100	0.00	0.00	1.64	
In Zone:	**AC-1.1**											
	In Wall:	**WEST WALL**										
1	DOOR	DOOR	No	7.00	7.00	1	49.0	0.6100	0.00	0.00	1.64	
In Zone:	**AC-1.3**											
	In Wall:	**WEST WALL**										
1	DOOR	DOOR	No	3.50	7.00	1	24.5	0.6100	0.00	0.00	1.64	
In Zone:	**STAIR-132**											
	In Wall:	**SOUTH WALL**										
1	DOOR	DOOR	No	3.00	7.00	1	21.0	0.6100	0.00	0.00	1.64	
In Zone:	**STAIR-157**											
	In Wall:	**SOUTH WALL**										
1	DOOR	DOOR	No	3.00	7.00	1	21.0	0.6100	0.00	0.00	1.64	
In Zone:	**STAIR-187**											
	In Wall:	**WEST WALL**										
1	DOOR	DOOR	No	3.00	7.00	1	21.0	0.6100	0.00	0.00	1.64	
In Zone:	**STAIR-132**											
	In Wall:	**NORTH WALL**										
1	DOOR	DOOR	No	3.00	7.00	1	21.0	0.6100	0.00	0.00	1.64	
In Zone:	**UNCONDITIONED**											
	In Wall:	**WEST WALL**										
1	DOOR	DOOR	No	3.00	7.00	1	21.0	0.6100	0.00	0.00	1.64	
	In Wall:	**WEST WALL**										
1	DOOR	DOOR	No	3.00	7.00	1	21.0	0.6100	0.00	0.00	1.64	
	In Wall:	**WEST WALL**										
1	DOOR	DOOR	No	3.00	7.00	1	21.0	0.6100	0.00	0.00	1.64	

Roofs

No	Description	Type	Width [ft]	H (Effec) [ft]	Multi plier	Area [sf]	Tilt [deg]	Cond. [Btu/h.Sf. F]	Heat Cap [Btu/sf. F]	Dens. [lb/cf]	R-Value [h.sf.F/Bt
In Zone:	**FCU-1.5**										
1	LOBBY 122	ROOF	51.24	10.00	1	512.4	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.1**										
1	LOBBY 122	ROOF	277.90	1.00	1	277.9	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.2**										
1	LOBBY 122	ROOF	132.70	10.00	1	1327.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.3**										
1	LOBBY 122	ROOF	980.70	1.00	1	980.7	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.4**										
1	LOBBY 122	ROOF	219.10	1.00	1	219.1	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.5**										
1	LOBBY 122	ROOF	875.70	1.00	1	875.7	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.6**										
1	LOBBY 122	ROOF	1414.00	1.00	1	1414.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.7**										
1	LOBBY 122	ROOF	165.13	10.00	1	1651.3	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.8**										
1	LOBBY 122	ROOF	289.80	1.00	1	289.8	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.9**										
1	LOBBY 122	ROOF	982.80	1.00	1	982.8	0.00	0.0388	4.87	47.73	25.8
In Zone:	**FCU-2.10**										
1	LOBBY 122	ROOF	599.90	1.00	1	599.9	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA458**										
1	LOBBY 122	ROOF	320.60	1.00	1	320.6	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA458**										
1	LOBBY 122	ROOF	320.60	1.00	1	320.6	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA458**										
1	LOBBY 122	ROOF	320.60	1.00	1	320.6	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA478**										
1	LOBBY 122	ROOF	334.60	1.00	1	334.6	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA610**										
1	LOBBY 122	ROOF	427.00	1.00	1	427.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA465**										
1	LOBBY 122	ROOF	325.50	1.00	1	325.5	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA451**										
1	LOBBY 122	ROOF	315.40	1.00	1	315.4	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA473**										
1	LOBBY 122	ROOF	331.10	1.00	1	331.1	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA521**										
1	LOBBY 122	ROOF	364.70	1.00	1	364.7	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA564**										
1	LOBBY 122	ROOF	394.80	1.00	1	394.8	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA476**										
1	LOBBY 122	ROOF	333.20	1.00	1	333.2	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA516**										
1	LOBBY 122	ROOF	361.20	1.00	1	361.2	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA588**										
1	LOBBY 122	ROOF	411.60	1.00	1	411.6	0.00	0.0388	4.87	47.73	25.8
In Zone:	**SEMI PRV-L2-AREA437**										

1	LOBBY 122	ROOF	305.90	1.00	1	305.9	0.00	0.0388	4.87	47.73	25.8
In Zone:	**PRV-L2-AREA470**										
1	LOBBY 122	ROOF	329.00	1.00	1	329.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**PRV-L2-AREA480**										
1	LOBBY 122	ROOF	336.00	1.00	1	336.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**PRV-L2-AREA395**										
1	LOBBY 122	ROOF	276.50	1.00	1	276.5	0.00	0.0388	4.87	47.73	25.8
In Zone:	**MAU-1**										
1	LOBBY 122	ROOF	261.38	10.00	1	2613.8	0.00	0.0388	4.87	47.73	25.8
In Zone:	**MAU-2**										
1	LOBBY 122	ROOF	1892.40	1.00	1	1892.4	0.00	0.0388	4.87	47.73	25.8
In Zone:	**MAU-3**										
1	LOBBY 122	ROOF	226.90	10.00	1	2269.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**MAU-4**										
1	LOBBY 122	ROOF	1961.87	1.00	1	1961.9	0.00	0.0388	4.87	47.73	25.8
In Zone:	**STAIR-132**										
1	LOBBY 122	ROOF	200.00	1.00	1	200.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**STAIR-157**										
1	LOBBY 122	ROOF	200.00	1.00	1	200.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**STAIR-187**										
1	LOBBY 122	ROOF	229.00	1.00	1	229.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**STAIR-132**										
1	LOBBY 122	ROOF	200.00	1.00	1	200.0	0.00	0.0388	4.87	47.73	25.8
In Zone:	**UNCONDITIONED**										
1	LOBBY 122	ROOF	388.00	1.00	1	388.0	0.00	0.0388	4.87	47.73	25.8

Skylights

No	Description	Type	U [Btu/hr sf F]	SHGC	Vis.Trans	W [ft]	H (Effec) [ft]	Multi-plier	Area [Sf]	Total Area [Sf]

In Zone:

In Roof:

Floors

No	Description	Type	Width [ft]	H (Effec) [ft]	Multiplier	Area [sf]	Cond. [Btu/h.sf.F	Heat Cap. [Btu/sf. F]	Dens. [lb/cf]	R-Value [h.sf.F/Btu
In Zone:	**FCU-1.1**									
1	FLOOR	FLOOR	476.00	1.00	1	476.0	0.1400			7.14
In Zone:	**FCU-1.2**									
1	FLOOR	FLOOR	257.60	1.00	1	257.6	0.1400			7.14
In Zone:	**FCU-1.3**									
1	FLOOR	FLOOR	164.50	1.00	1	164.5	0.1400			7.14
In Zone:	**FCU-1.4**									
1	FLOOR	FLOOR	626.19	1.00	1	626.2	0.1400			7.14
In Zone:	**FCU-1.5**									
1	FLOOR	FLOOR	625.80	1.00	1	625.8	0.1400			7.14
In Zone:	**FCU-1.6**									
1	FLOOR	FLOOR	742.00	1.00	1	742.0	0.1400			7.14
In Zone:	**FCU-1.7**									
1	FLOOR	FLOOR	792.40	1.00	1	792.4	0.1400			7.14
In Zone:	**FCU-1.8**									
1	FLOOR	FLOOR	75.53	10.00	1	755.3	0.1400			7.14
In Zone:	**FCU-1.9**									
1	FLOOR	FLOOR	396.20	1.00	1	396.2	0.1400			7.14
In Zone:	**FCU-1.10**									
1	FLOOR	FLOOR	419.30	1.00	1	419.3	0.1400			7.14
In Zone:	**FCU-1.11**									
1	FLOOR	FLOOR	548.10	1.00	1	548.1	0.1400			7.14
In Zone:	**FCU-1.12**									
1	FLOOR	FLOOR	329.70	1.00	1	329.7	0.1400			7.14
In Zone:	**FCU-1.13**									
1	FLOOR	FLOOR	261.60	10.00	1	2616.0	0.1400			7.14
In Zone:	**FCU-1.14**									
1	FLOOR	FLOOR	410.90	1.00	1	410.9	0.1400			7.14
In Zone:	**FCU-1.15**									
1	FLOOR	FLOOR	881.30	1.00	1	881.3	0.1400			7.14
In Zone:	**FCU-1.16**									
1	FLOOR	FLOOR	362.60	1.00	1	362.6	0.1400			7.14
In Zone:	**FCU-1.17**									
1	FLOOR	FLOOR	1401.10	1.00	1	1401.1	0.1400			7.14
In Zone:	**FCU-1.18**									
1	FLOOR	FLOOR	239.00	10.00	1	2390.0	0.1400			7.14
In Zone:	**FCU-1.19**									
1	FLOOR	FLOOR	99.61	10.00	1	996.1	0.1400			7.14
In Zone:	**FCU-1.20**									
1	FLOOR	FLOOR	289.80	1.00	1	289.8	0.1400			7.14
In Zone:	**FCU-1.21**									
1	FLOOR	FLOOR	444.50	1.00	1	444.5	0.1400			7.14
In Zone:	**FCU-1.22A**									
1	FLOOR	FLOOR	402.50	1.00	1	402.5	0.1400			7.14
In Zone:	**FCU-1.22B**									
1	FLOOR	FLOOR	744.10	1.00	1	744.1	0.1400			7.14
In Zone:	**AC-1.1**									
1	FLOOR	FLOOR	179.00	1.00	1	179.0	0.1400			7.14
In Zone:	**AC-1.2**									
1	FLOOR	FLOOR	169.00	1.00	1	169.0	0.1400			7.14
In Zone:	**AC-1.3**									
1	FLOOR	FLOOR	179.00	1.00	1	179.0	0.1400			7.14

In Zone:	**AC-1.4**							
1	FLOOR	FLOOR	99.00	1.00	1	99.0	0.1400	7.14
In Zone:	**AC-1.5**							
1	FLOOR	FLOOR	252.00	1.00	1	252.0	0.1400	7.14
In Zone:	**AC-2.1**							
1	FLOOR	FLOOR	179.00	1.00	1	179.0	0.1400	7.14
In Zone:	**AC-2.2**							
1	FLOOR	FLOOR	179.00	1.00	1	179.0	0.1400	7.14
In Zone:	**SEMI PRV-L1-AREA458**							
1	FLOOR	FLOOR	320.60	1.00	1	320.6	0.1400	7.14
In Zone:	**SEMI PRV-L1-AREA458**							
1	FLOOR	FLOOR	320.60	1.00	1	320.6	0.1400	7.14
In Zone:	**SEMI PRV-L1-AREA562**							
1	FLOOR	FLOOR	393.40	1.00	1	393.4	0.1400	7.14
In Zone:	**SEMI PRV-L1-AREA586**							
1	FLOOR	FLOOR	410.20	1.00	1	410.2	0.1400	7.14
In Zone:	**SEMI PRV-L1-AREA437**							
1	FLOOR	FLOOR	305.90	1.00	1	305.9	0.1400	7.14
In Zone:	**SEMI PRV-L1-AREA476**							
1	FLOOR	FLOOR	333.20	1.00	1	333.2	0.1400	7.14
In Zone:	**SEMI PRV-L1-AREA516**							
1	FLOOR	FLOOR	361.20	1.00	1	361.2	0.1400	7.14
In Zone:	**MAU-1**							
1	FLOOR	FLOOR	1287.28	10.00	1	12872.8	0.1400	7.14
In Zone:	**MAU-2**							
1	FLOOR	FLOOR	230.70	10.00	1	2307.0	0.1400	7.14
In Zone:	**MAU-3**							
1	FLOOR	FLOOR	308.49	10.00	1	3084.9	0.1400	7.14
In Zone:	**MAU-4**							
1	FLOOR	FLOOR	1900.00	1.00	1	1900.0	0.1400	7.14
In Zone:	**STAIR-132**							
1	FLOOR	FLOOR	200.00	1.00	1	200.0	0.1400	7.14
In Zone:	**STAIR-157**							
1	FLOOR	FLOOR	200.00	1.00	1	200.0	0.1400	7.14
In Zone:	**STAIR-187**							
1	FLOOR	FLOOR	229.00	1.00	1	229.0	0.1400	7.14
In Zone:	**STAIR-132**							
1	FLOOR	FLOOR	200.00	1.00	1	200.0	0.1400	7.14
In Zone:	**UNCONDITIONED**							
1	FLOOR	FLOOR	555.00	1.00	1	555.0	0.1400	7.14

Systems

FCU-1.1 **FCU-1.1** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	20800.00	14.30	8.00	☐
2	Heating System	28000.00	3.70		☐
3	Air Handling System -Supply	590.00	0.39		☐

FCU-1.2 **FCU-1.2** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	19600.00	14.30	8.00	☐
2	Heating System	28000.00	3.70		☐
3	Air Handling System -Supply	350.00	0.60		☐

FCU-1.3 **FCU-1.3** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	12300.00	14.30	8.00	☐
2	Heating System	17700.00	3.70		☐
3	Air Handling System -Supply	230.00	0.59		☐

FCU-1.4 **FCU-1.4** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	15700.00	14.30	8.00	☐
2	Heating System	20900.00	3.70		☐
3	Air Handling System -Supply	600.00	0.38		☐

FCU-1.5 **FCU-1.5** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	41300.00	14.30	8.00	☐
2	Heating System	56100.00	3.70		☐
3	Air Handling System -Supply	1280.00	0.23		☐

FCU-1.6 **FCU-1.6** **Constant Volume Air Cooled Split System < 65000 Btu/hr** **No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	32.70	14.30	8.00	☐
2	Heating System	41500.00	3.70		☐
3	Air Handling System -Supply	1065.00	0.28		☐

FCU-1.7	FCU-1.7	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	32.70	14.30	8.00
2	Heating System	41500.00	3.70	
3	Air Handling System -Supply	1065.00	0.28	

FCU-1.8	FCU-1.8	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	13500.00	14.30	8.00
2	Heating System	17700.00	3.70	
3	Air Handling System -Supply	420.00	0.30	

FCU-1.9	FCU-1.9	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	8100.00	14.30	8.00
2	Heating System	10900.00	3.70	
3	Air Handling System -Supply	300.00	0.26	

FCU-1.10	FCU-1.10	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	14900.00	14.30	8.00
2	Heating System	20900.00	3.70	
3	Air Handling System -Supply	495.00	0.46	

FCU-1.11	FCU-1.11	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	21400.00	14.30	8.00
2	Heating System	28000.00	3.70	
3	Air Handling System -Supply	580.00	0.39	

FCU-1.12	FCU-1.12	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	13100.00	14.30	8.00
2	Heating System	17700.00	3.70	
3	Air Handling System -Supply	430.00	0.30	

FCU-1.13	FCU-1.13	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	33700.00	14.30	8.00
2	Heating System	41500.00	3.70	
3	Air Handling System -Supply	935.00	0.32	

FCU-1.14	FCU-1.14	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	19600.00	14.30	8.00
2	Heating System	28000.00	3.70	
3	Air Handling System -Supply	610.00	0.49	

FCU-1.15	FCU-1.15	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	32000.00	14.30	8.00
2	Heating System	41500.00	3.70	
3	Air Handling System -Supply	1000.00	0.23	

FCU-1.16	FCU-1.16	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	13300.00	14.30	8.00
2	Heating System	17600.00	4.00	
3	Air Handling System -Supply	350.00	0.37	

FCU-1.17	FCU-1.17	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	29800.00	14.30	8.00
2	Heating System	41500.00	4.00	
3	Air Handling System -Supply	895.00	0.25	

FCU-1.18	FCU-1.18	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	33700.00	14.30	8.00
2	Heating System	41500.00	4.00	
3	Air Handling System -Supply	935.00	0.30	

FCU-1.19	FCU-1.19	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	13100.00	14.30	8.00
2	Heating System	17700.00	3.50	
3	Air Handling System -Supply	420.00	0.30	

FCU-1.20	FCU-1.20	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	12700.00	14.30	8.00
2	Heating System	17700.00	3.50	
3	Air Handling System -Supply	355.00	0.36	

FCU-1.21	FCU-1.21	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	21400.00	14.30	8.00
2	Heating System	30000.00	3.50	
3	Air Handling System -Supply	560.00	0.40	

FCU-1.22A	FCU-1.22A	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	61700.00	14.30	8.00
2	Heating System	46000.00	3.70	
3	Air Handling System -Supply	1560.00	0.48	

FCU-1.22B	FCU-1.22B	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	61700.00	14.30	8.00
2	Heating System	46000.00	3.70	
3	Air Handling System -Supply	1560.00	0.48	

FCU-2.1	FCU-2.1	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	21600.00	14.30	8.00
2	Heating System	28000.00	3.50	
3	Air Handling System -Supply	630.00	0.36	

FCU-2.2	FCU-2.2	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	21800.00	14.30	8.00
2	Heating System	28000.00	3.50	
3	Air Handling System -Supply	630.00	0.36	

FCU-2.3	FCU-2.3	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	13500.00	14.30	8.00
2	Heating System	17600.00	3.50	
3	Air Handling System -Supply	420.00	0.30	

FCU-2.4	FCU-2.4	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	33700.00	14.30	8.00
2	Heating System	41500.00	3.50	
3	Air Handling System -Supply	560.00	0.50	

FCU-2.5	FCU-2.5	Constant Volume Packaged System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	72700.00	12.50	14.80
2	Heating System	84000.00	1.00	
3	Air Handling System -Supply	1500.00	0.80	

FCU-2.6	FCU-2.6	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	57600.00	14.30	8.00
2	Heating System	65600.00	3.80	
3	Air Handling System -Supply	1450.00	0.24	

FCU-2.7	FCU-2.7	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	13400.00	14.30	8.00
2	Heating System	17700.00	3.80	
3	Air Handling System -Supply	460.00	0.28	

FCU-2.8	FCU-2.8	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	12800.00	14.30	8.00
2	Heating System	17700.00	3.50	
3	Air Handling System -Supply	365.00	0.35	

FCU-2.9	FCU-2.9	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	21400.00	14.30	8.00
2	Heating System	30000.00	3.50	
3	Air Handling System -Supply	420.00	0.30	

FCU-2.10	FCU-2.10	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	32700.00	14.30	8.00
2	Heating System	41500.00	3.50	
3	Air Handling System -Supply	700.00	0.48	

AC-1.1	AC-1.1	Constant Volume Air Cooled Split System < 65000 Btu/hr		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	12000.00	14.30	8.00
2	Air Handling System -Supply	250.00	0.10	

AC-1.2	**AC-1.2**	**Constant Volume Air Cooled Split System < 65000 Btu/hr**	**No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	12000.00	14.30	8.00	☐
2	Air Handling System -Supply	250.00	0.10		☐

AC-1.3	**AC-1.3**	**Constant Volume Air Cooled Split System < 65000 Btu/hr**	**No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	12000.00	14.30	8.00	☐
2	Air Handling System -Supply	250.00	0.10		☐

AC-1.4	**AC-1.4**	**Constant Volume Air Cooled Split System < 65000 Btu/hr**	**No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	12000.00	14.30	8.00	☐
2	Air Handling System -Supply	250.00	0.10		☐

AC-1.5	**AC-1.5**	**Constant Volume Air Cooled Split System < 65000 Btu/hr**	**No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	12000.00	14.30	8.00	☐
2	Air Handling System -Supply	250.00	0.10		☐

AC-2.1	**AC-2.1**	**Constant Volume Air Cooled Split System < 65000 Btu/hr**	**No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	12000.00	14.30	8.00	☐
2	Air Handling System -Supply	250.00	0.10		☐

AC-2.2	**AC-2.2**	**Constant Volume Air Cooled Split System < 65000 Btu/hr**	**No. Of Units 1**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	12000.00	14.30	8.00	☐
2	Air Handling System -Supply	250.00	0.10		☐

FCU-A/ AREA-458 L1	**FCU-A/ AREA-458**	**Variable refrigerant Flow System**	**No. Of Units 6**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	6900.00	13.00	8.00	☐
2	Heating System	8900.00	1.00		☐
3	Air Handling System -Supply	225.00	0.20		☐

FCU-A/ AREA-458 L1	**FCU-A/ AREA-458**	**Variable refrigerant Flow System**	**No. Of Units 6**

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	6900.00	13.00	8.00	☐
2	Heating System	8900.00	1.00		☐
3	Air Handling System -Supply	225.00	0.20		☐

FCU-A/ AREA-562 L1	FCU-A/ AREA-562	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-586 L1	FCU-A/ AREA-586	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-437 L1	FCU-A/ AREA-437	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-476 L1	FCU-A/ AREA-476	Variable refrigerant Flow System		No. Of Units 2
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-516 L1	FCU-A/ AREA-516	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-458 L2	FCU-A/ AREA-458	Variable refrigerant Flow System		No. Of Units 8
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-458 L2	FCU-A/ AREA-458	Variable refrigerant Flow System		No. Of Units 8
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-458 L2	FCU-A/ AREA-458	Variable refrigerant Flow System		No. Of Units 7
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-478 L2	FCU-A/ AREA-478	Variable refrigerant Flow System		No. Of Units 4
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-610 L2	FCU-A/ AREA-610	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-465 L2	FCU-A/ AREA-465	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-451 L2	FCU-A/ AREA-451	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-473 L2	FCU-A/ AREA-473	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-521 L2	FCU-A/ AREA-521	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-564 L2	FCU-A/ AREA-564	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-476 L2	FCU-A/ AREA-476	Variable refrigerant Flow System		No. Of Units 2
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-516 L2	FCU-A/ AREA-516	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-588 L2	FCU-A/ AREA-588	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-A/ AREA-437 L2	FCU-A/ AREA-437	Variable refrigerant Flow System		No. Of Units 2
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	6900.00	13.00	8.00
2	Heating System	8900.00	1.00	
3	Air Handling System -Supply	225.00	0.20	

FCU-B/ AREA-470 L2	FCU-B/ AREA-470	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	11100.00	13.00	8.00
2	Heating System	14000.00	1.00	
3	Air Handling System -Supply	350.00	0.20	

FCU-B/ AREA-480 L2	FCU-B/ AREA-480	Variable refrigerant Flow System		No. Of Units 1
Component	**Category**	**Capacity**	**Efficiency**	**IPLV**
1	Cooling System	11100.00	13.00	8.00
2	Heating System	14000.00	1.00	
3	Air Handling System -Supply	350.00	0.20	

FCU-B/ AREA-395 L2	FCU-B/ AREA-395	Variable refrigerant Flow System	No. Of Units 1

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	11100.00	13.00	8.00	☐
2	Heating System	14000.00	1.00		☐
3	Air Handling System -Supply	350.00	0.20		☐

MAU-1	MAU-1	Constant Volume Packaged System--902	No. Of Units 1

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	253660.00	14.30	13.00	☐
2	Heating System	240000.00	80.00		☐
3	Air Handling System -Supply	4120.00	0.80		☐

MAU-2	MAU-2	Constant Volume Packaged System--902	No. Of Units 1

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	198900.00	14.30	14.00	☐
2	Heating System	240000.00	80.00		☐
3	Air Handling System -Supply	3960.00	0.80		☐

MAU-3	MAU-3	Constant Volume Packaged System--902	No. Of Units 1

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	326970.00	14.30	14.00	☐
2	Heating System	240000.00	80.00		☐
3	Air Handling System -Supply	6130.00	0.80		☐

MAU-4	MAU-4	Constant Volume Packaged System--902	No. Of Units 1

Component	Category	Capacity	Efficiency	IPLV	
1	Cooling System	200530.00	14.30	14.00	☐
2	Heating System	240000.00	80.00		☐
3	Air Handling System -Supply	4210.00	0.80		☐

Plant

Equipment	Category	Size	Inst.NoEff.	IPLV

Water Heaters

	W-Heater Description	Capacity	Cap.Unit	I/P Rt.	Efficiency	Loss	
1	Gas Storage water heater (1 units)	27	[Gal]	1001 [Btu/h]	0.9400 [Ef/Et]	[Btu/h]	☐
2	Gas Storage water heater (1 units)	27	[Gal]	1001 [Btu/h]	0.9400 [Ef/Et]	[Btu/h]	☐

Ext-Lighting

	Description	Category	No. of Lumin-aires	Watts per Lumin-aire	Area/Len/No [sf/ft/No]	Control Type	Wattage [W]	
1	WE	Canopies (freestanding, attached and Overhangs)	1	20	100.00	Astronomical Timer C	20.00	☐
2	WE	Walk way less than 10 feet wide	2	20	100.00	Astronomical Timer C	40.00	☐
3	EX1	Walk way less than 10 feet wide	2	1	10.00	Astronomical Timer C	2.00	☐
4	WE	Main entries	1	20	200.00	Astronomical Timer C	20.00	☐
5	A	Canopies (freestanding, attached and Overhangs)	4	18	250.00	Astronomical Timer C	70.00	☐
6	A	Main entries	8	18	0.00	Astronomical Timer C	140.00	☐
7	WE	Walk way less than 10 feet wide	12	20	900.00	Astronomical Timer C	240.00	☐
8	G	Main entries	1	15	0.00	Astronomical Timer C	15.00	☐

Piping

	No	Type	Operating Temp [F]	Insulation Conductivity [Btu-in/h.sf.F]	Nomonal pipe Diameter [in]	Insulation Thickness [in]	Is Runout?	
1		Heating System (Steam, Steam Condensate, & Hot Water)	108.00	0.28	0.50	0.50	No	☐

Fenestration Used

Name	Glass Type	No. of Panes	Glass Conductance [Btu/h.sf.F]	SHGC	VLT
ASHULSglClrAll Frm	User Defined	1	1.2500	0.8200	0.7600
WINDOW (FIX)	User Defined	1	0.5000	0.2500	0.7600
WINDOW (OPERABLE)	User Defined	1	0.6500	0.2500	0.7600
ENTRANCE DOOR	User Defined	1	0.8300	0.2500	0.7600

Materials Used

Mat No	Acronym	Description	Only R-Value Used	RValue [h.sf.F/Btu]	Thick [ft]	Cond-uctivity [Btu/h.ft.F	Density [lb/cf]	Sp. Heat [Btu/lb.F]	
245	Matl245	PLYWOOD, 5/8IN	No	0.7894	0.0521	0.0660	34.00	0.2900	
1001	ApLbMat1001	R-6 generic Insulatrion	No	6.0000	0.1310	0.0218	0.30	0.2000	
1002	ApLbMat1002	CONC BLOCK MW,12IN,HOLLOW	Yes	6.0000					
1007	ApLbMat1007	POLYISO ROOF INSULATION	No	25.6385	0.3333	0.0130	1.50	0.3800	
1011	ApLbMat1011	2 in. Heavyweight concrete	No	0.1670	0.1670	1.0000	140.00	0.2000	

Constructs Used

No	Name	Simple Construct	Massless Construct	Conductance [Btu/h.sf.F]	Heat Cap [Btu/sf.F]	Density [lb/cf]	RValue [h.sf.F/Btu]	
1060	EXT WALL	No	No	0.08	0.52	9.89	12.8	☐

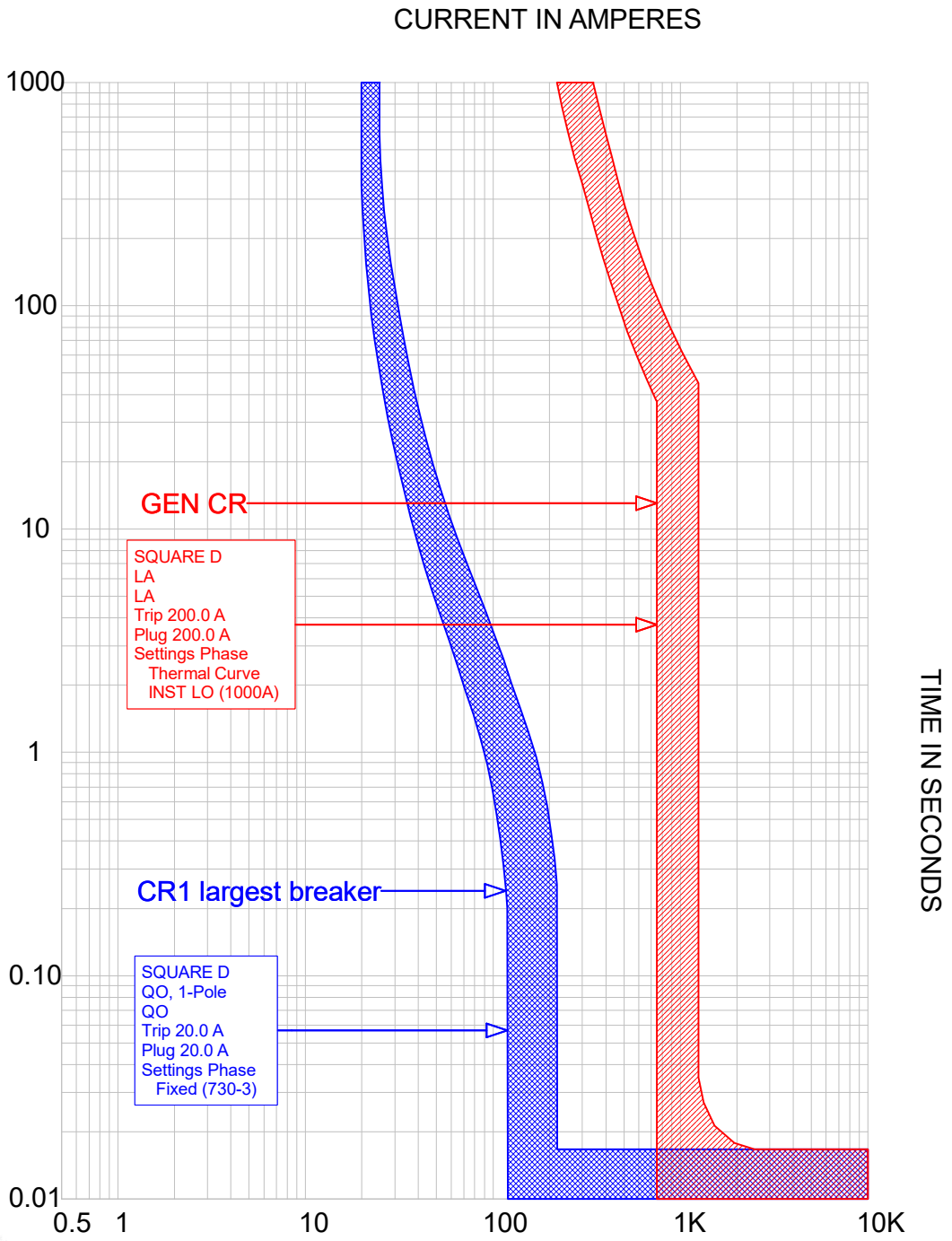
Layer	Material No.	Material	Thickness [ft]	Framing Factor	
1	245	PLYWOOD, 5/8IN	0.0521	0.000	☐
2	1001	R-6 generic Insulatrion	0.1310	0.000	☐
3	1002	CONC BLOCK MW,12IN,HOLLOW	1.0000	0.000	☐

No	Name	Simple Construct	Massless Construct	Conductance [Btu/h.sf.F]	Heat Cap [Btu/sf.F]	Density [lb/cf]	RValue [h.sf.F/Btu]	
1061	ROOF	No	No	0.04	4.87	47.73	25.8	☐

Layer	Material No.	Material	Thickness [ft]	Framing Factor	
1	1007	POLYISO ROOF INSULATION	0.3333	0.000	☐
2	1011	2 in. Heavyweight concrete	0.1670	0.000	☐

No	Name	Simple Construct	Massless Construct	Conductance [Btu/h.sf.F]	Heat Cap [Btu/sf.F]	Density [lb/cf]	RValue [h.sf.F/Btu]	
1062	FLOOR	Yes	Yes	0.14			7.1	☐

No	Name	Simple Construct	Massless Construct	Conductance [Btu/h.sf.F]	Heat Cap [Btu/sf.F]	Density [lb/cf]	RValue [h.sf.F/Btu]	
1063	DOOR	Yes	Yes	0.61			1.6	☐

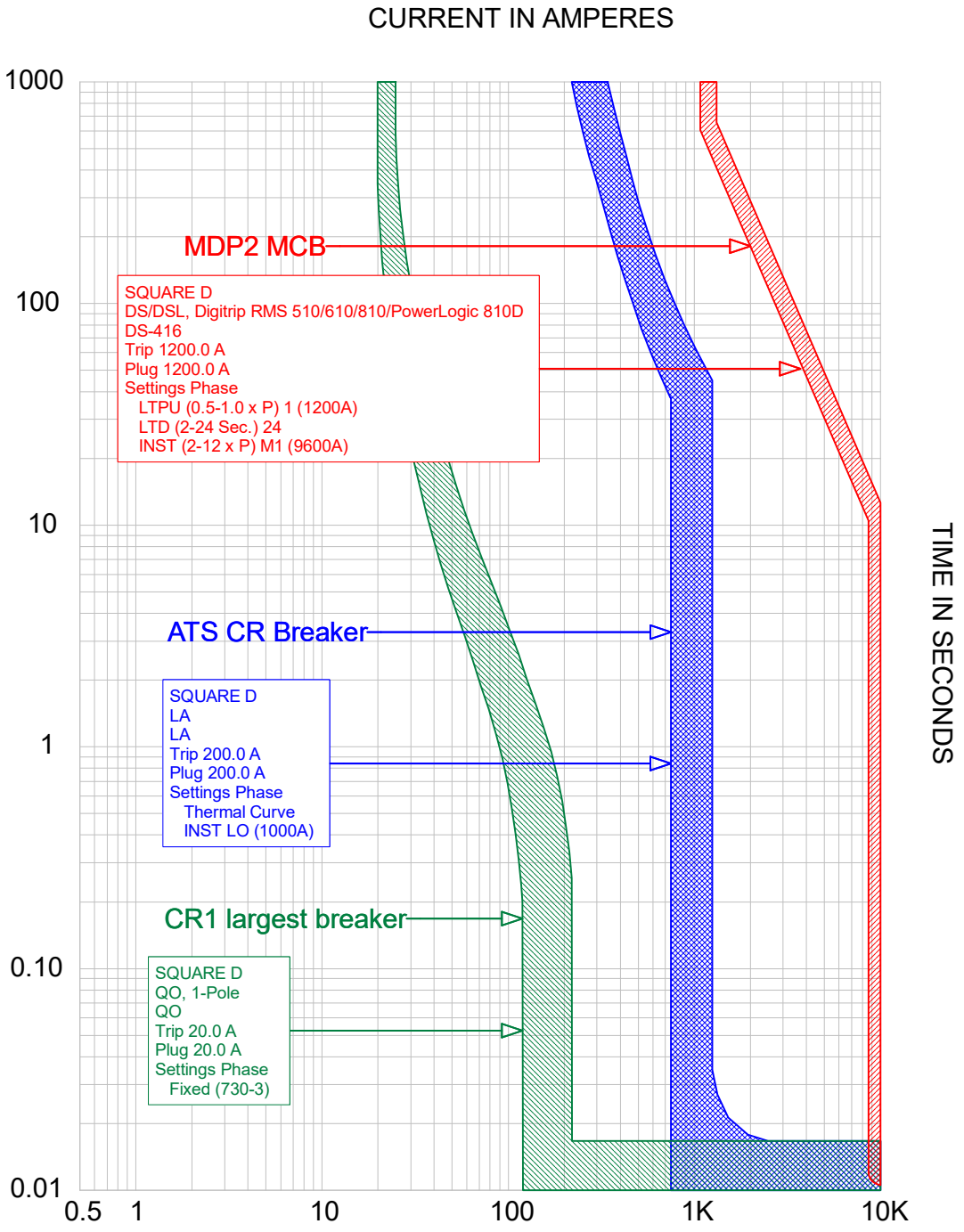


Panel CR1 Emergency.tcc Ref. Voltage: 208V Current in Amps x 1

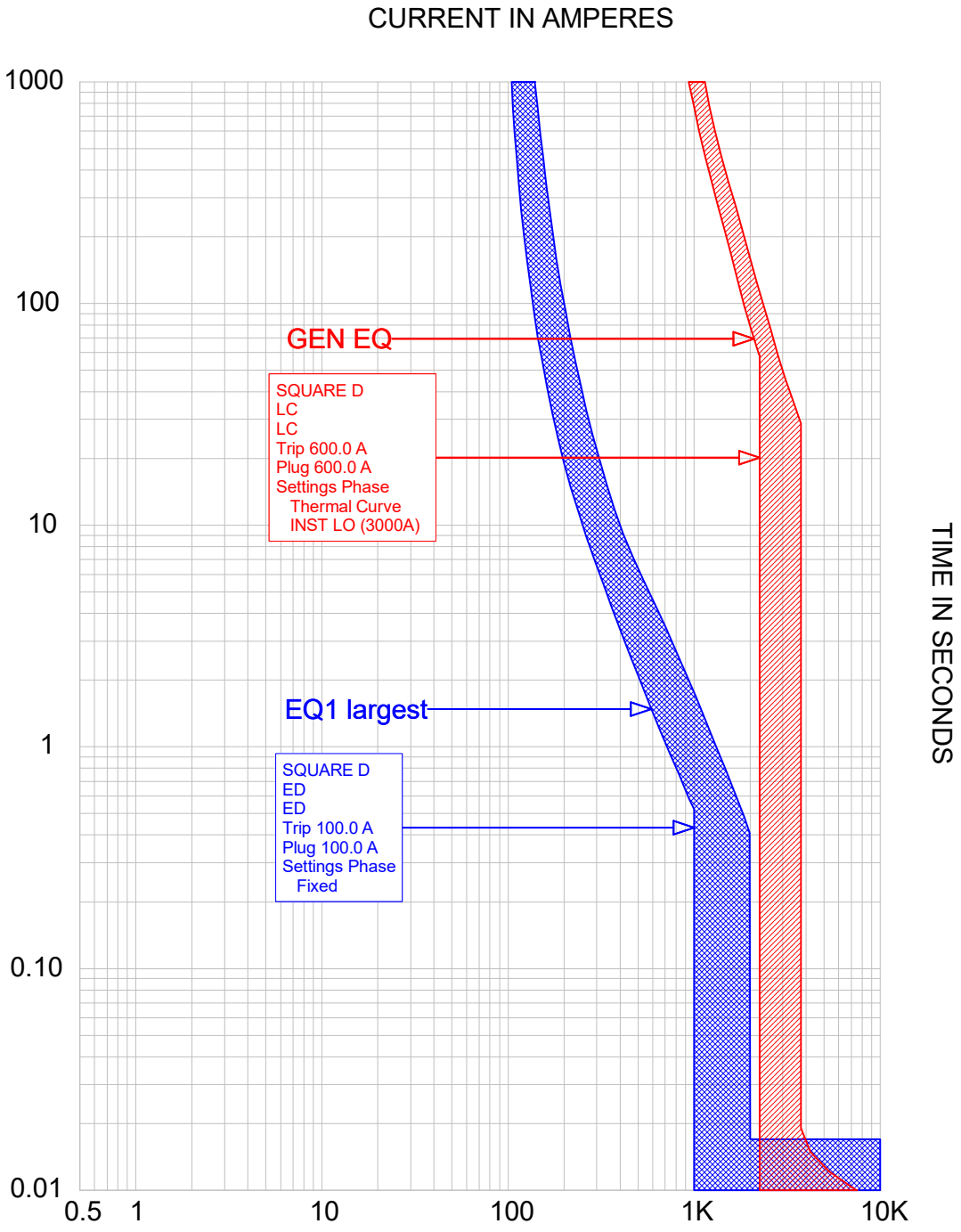
JOSEPH B. HARRILL LICENSE No.73015 STATE OF FLORIDA PROFESSIONAL ENGINEER

2024-08-19

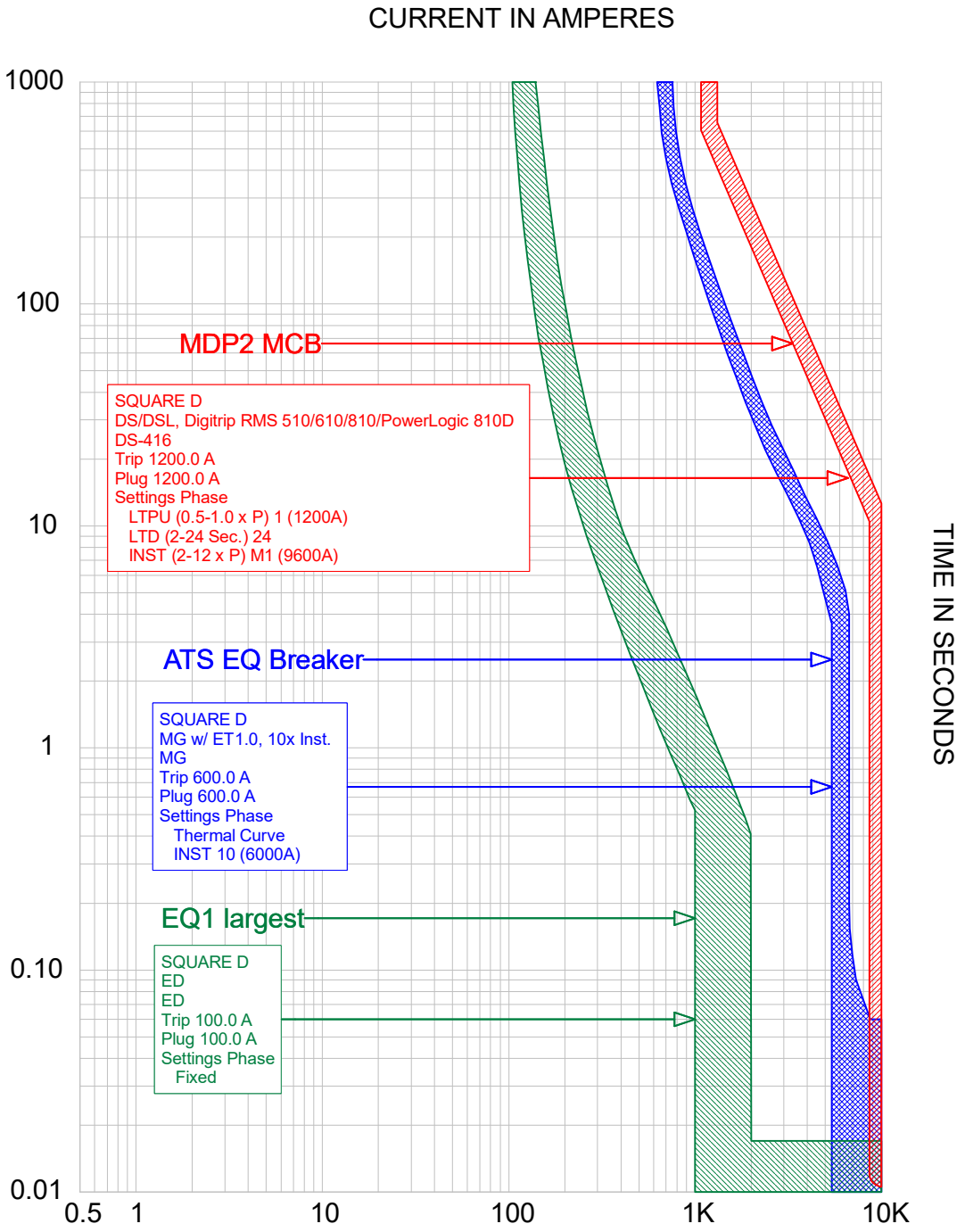
Joseph B. Harrill, PE 73015



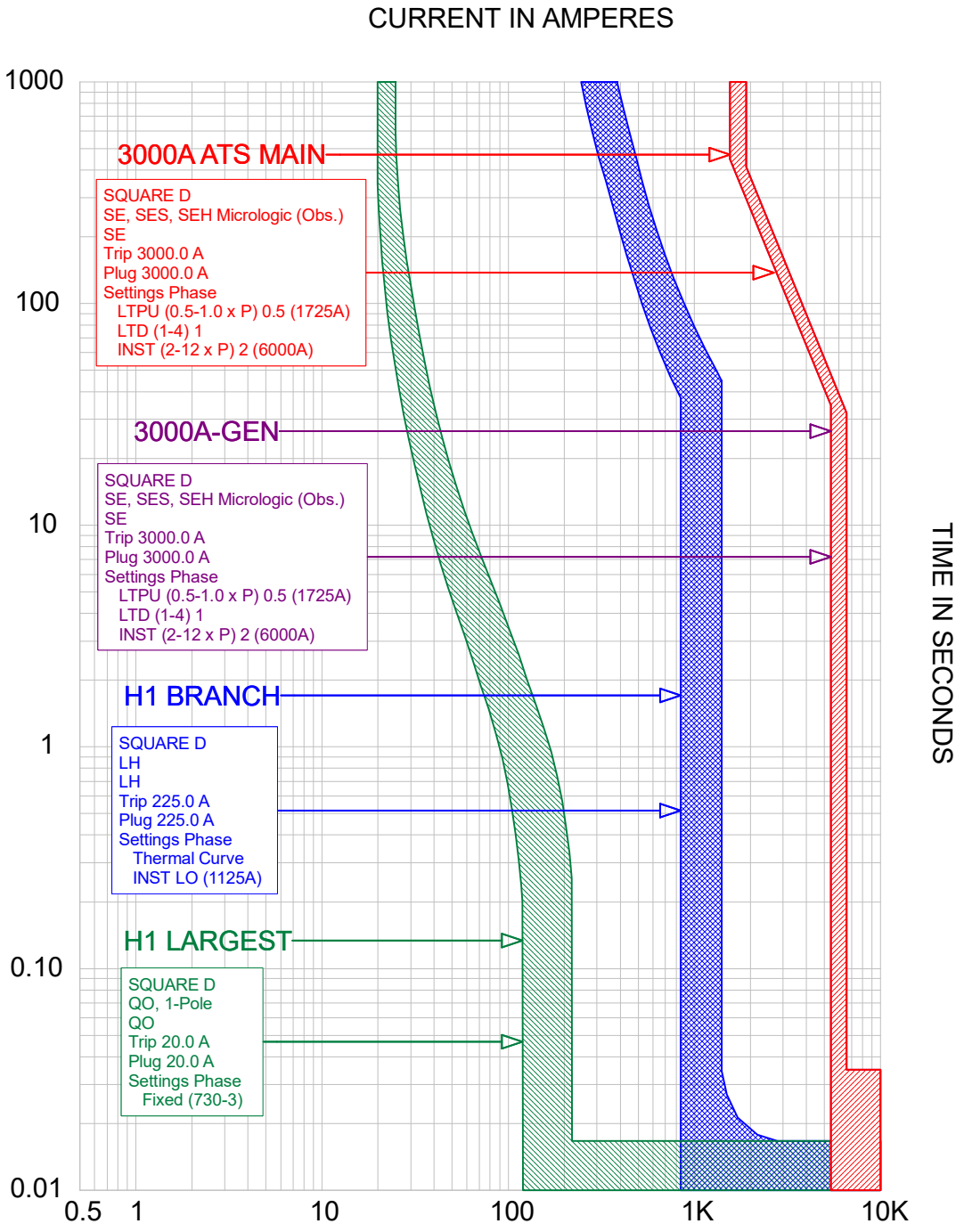
Panel CR1 Normal.tcc Ref. Voltage: 208V Current in Amps x 1



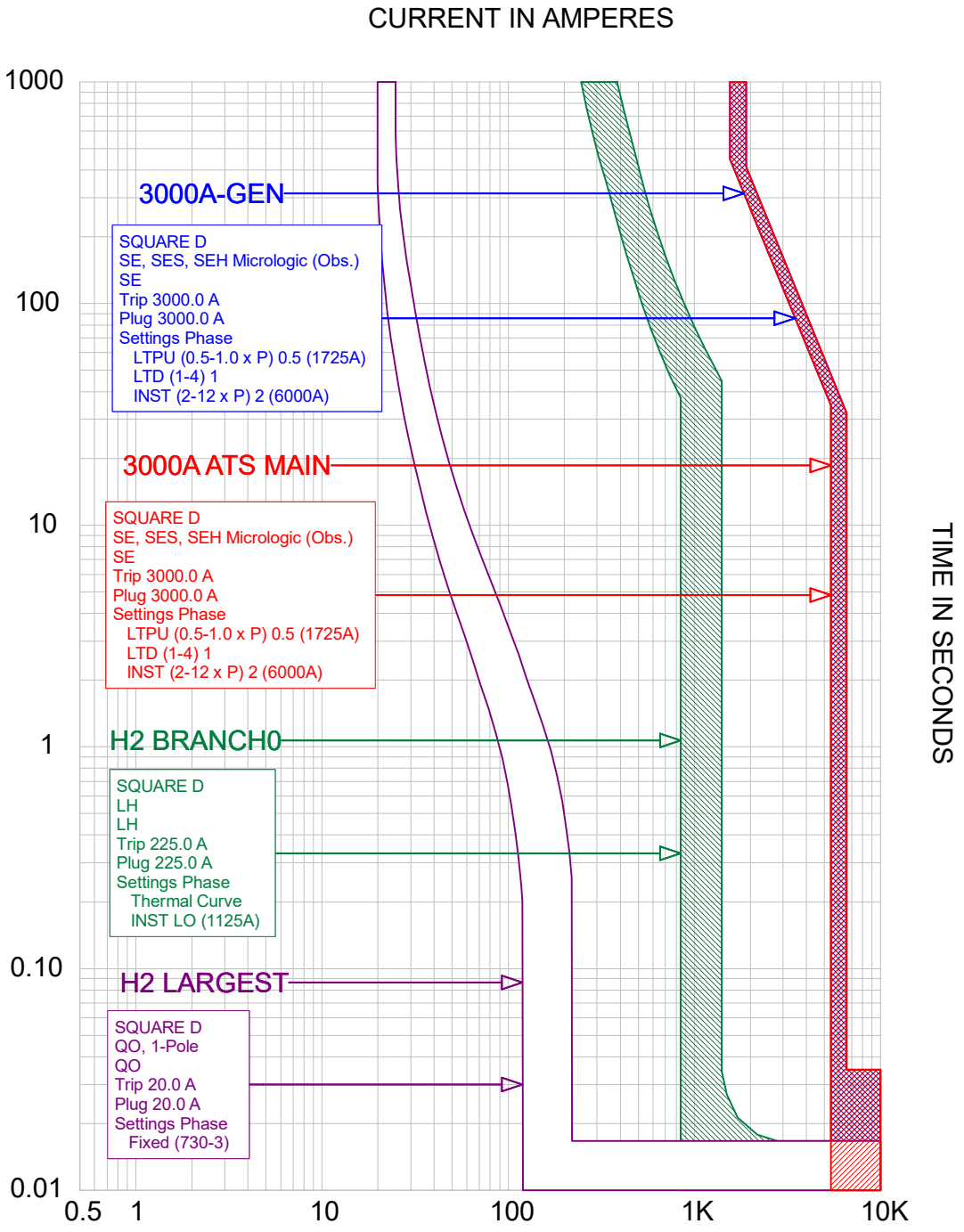
Panel EQ1 Emergency.tcc Ref. Voltage: 208V Current in Amps x 1



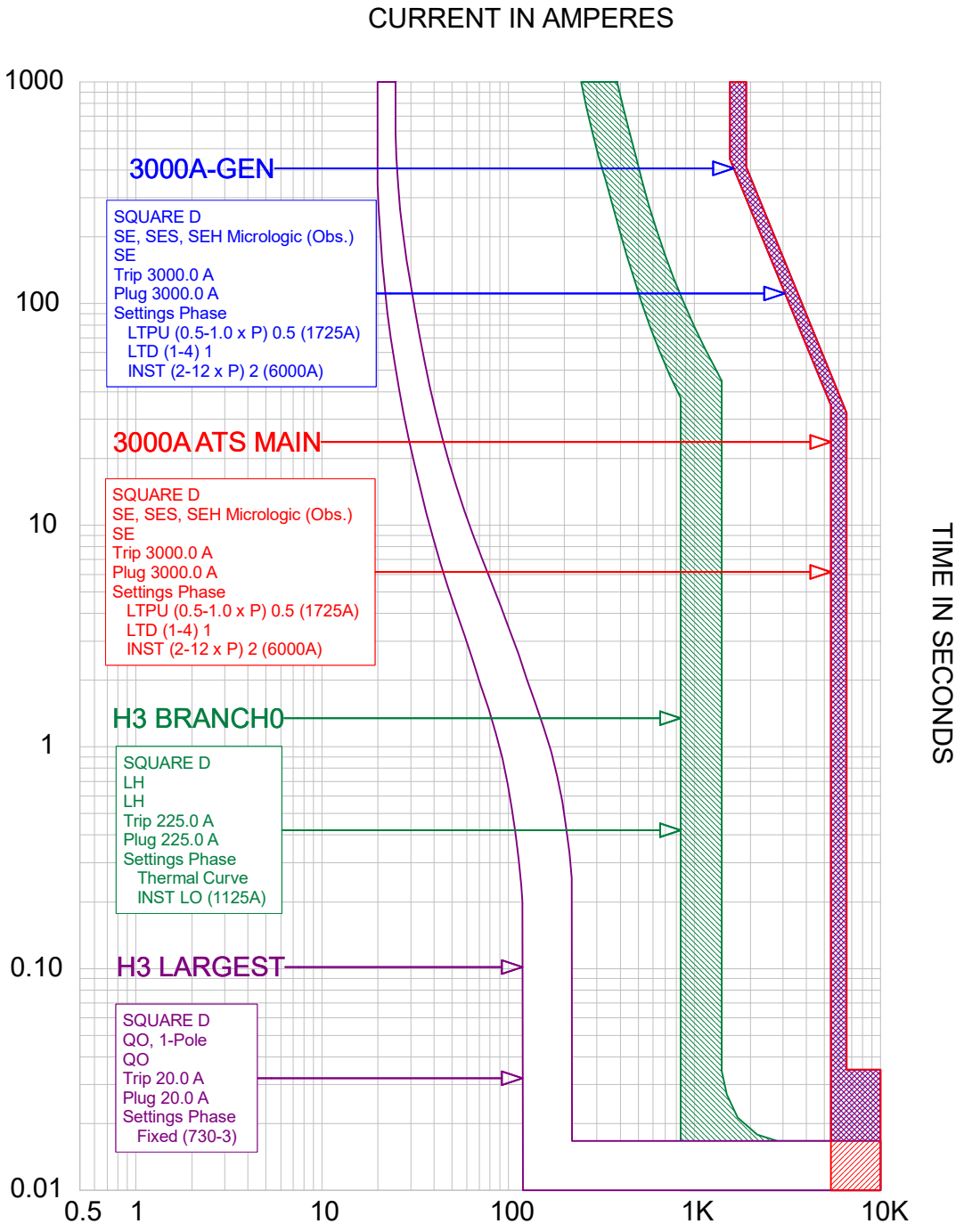
Panel EQ1 Normal.tcc Ref. Voltage: 208V Current in Amps x 1



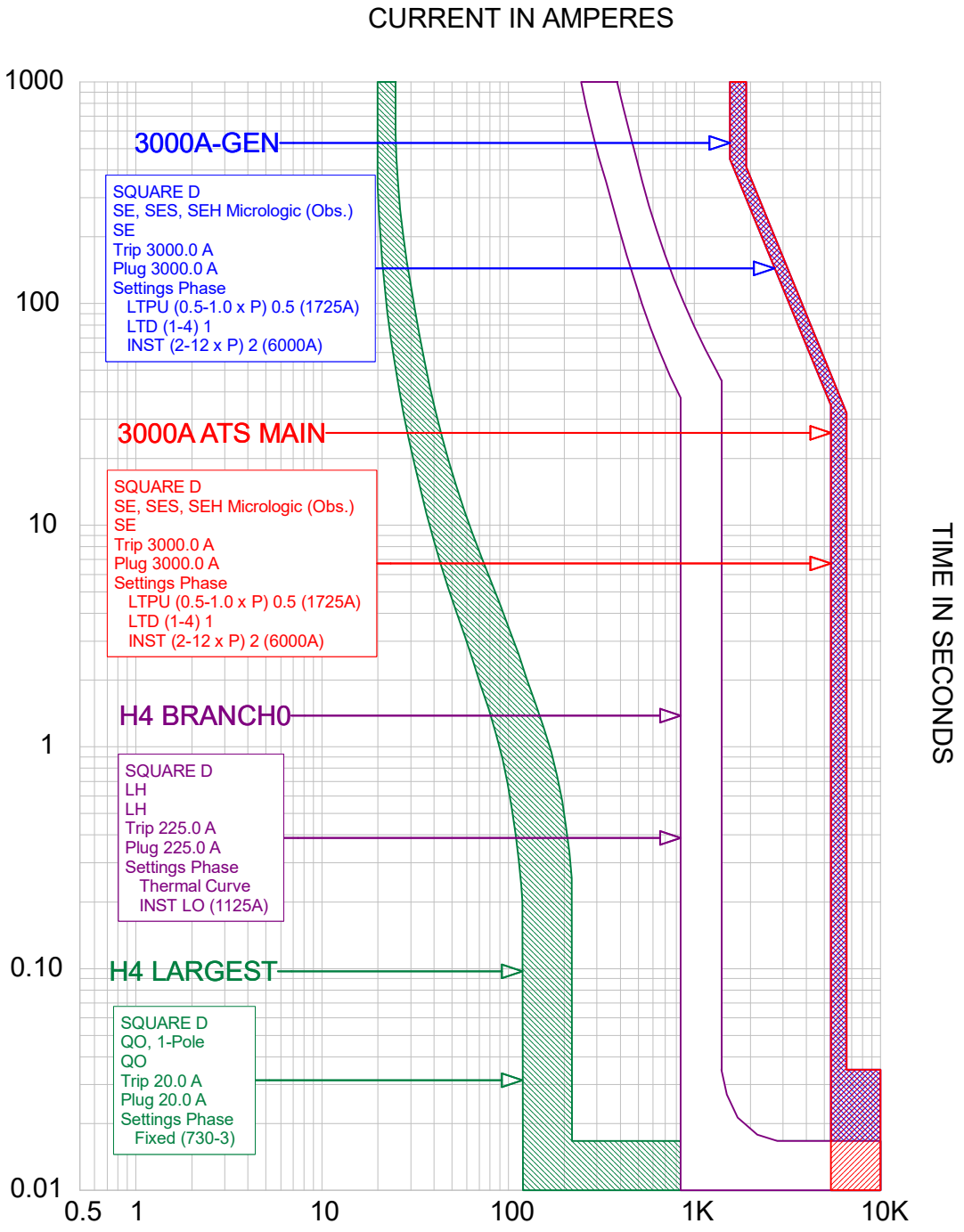
Panel H1.tcc Ref. Voltage: 208V Current in Amps x 1



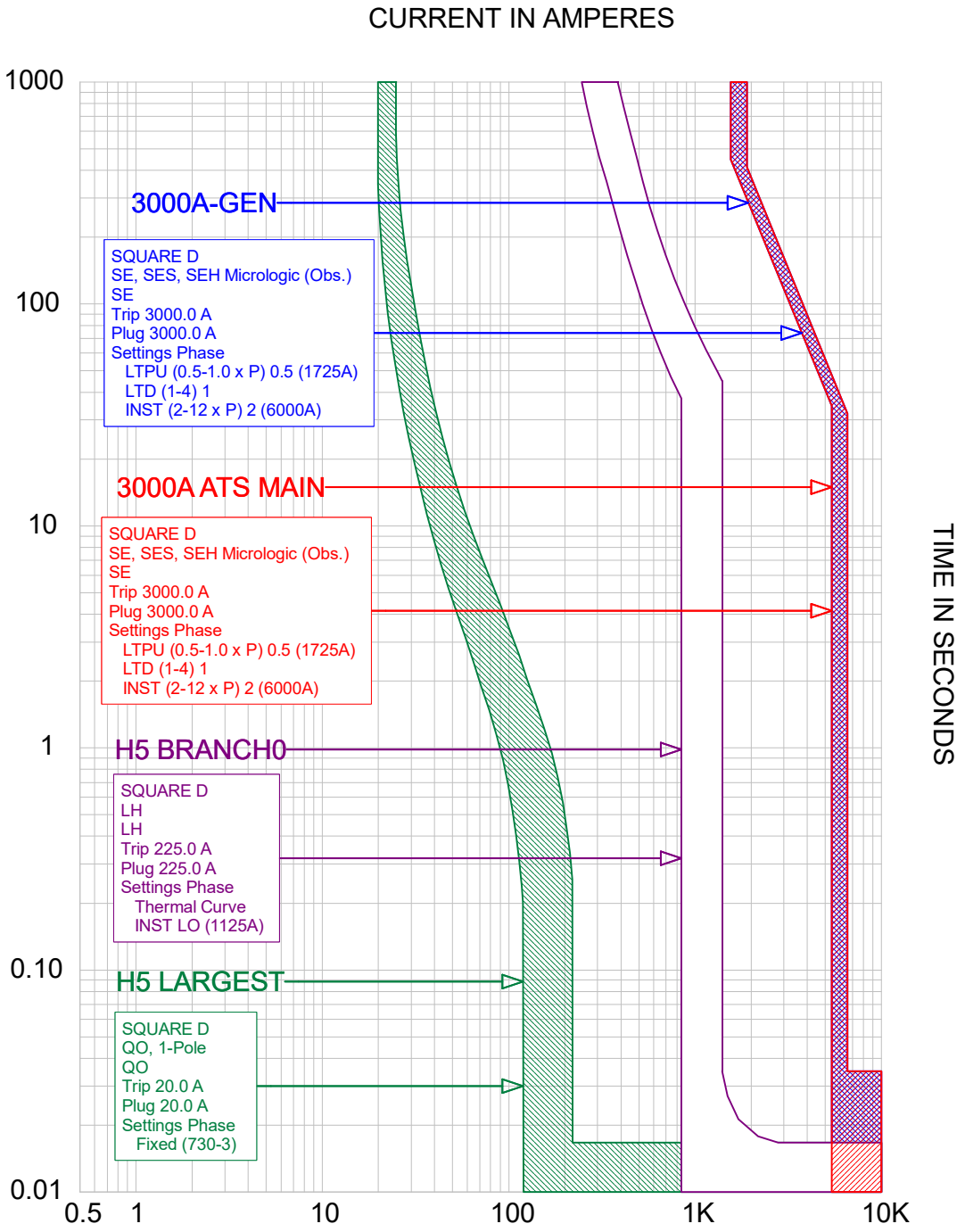
Panel H2.tcc Ref. Voltage: 208V Current in Amps x 1



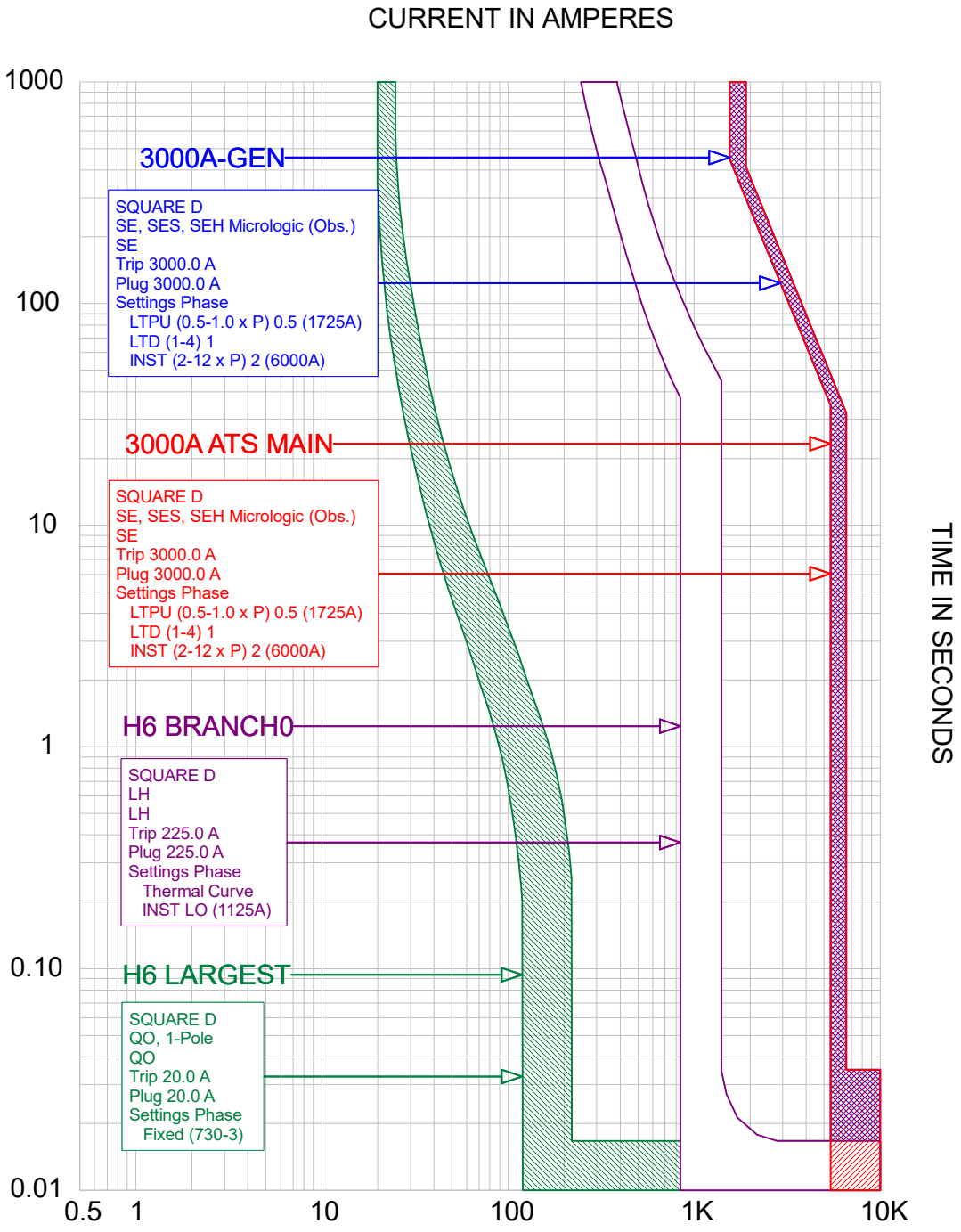
Panel H3.tcc Ref. Voltage: 208V Current in Amps x 1



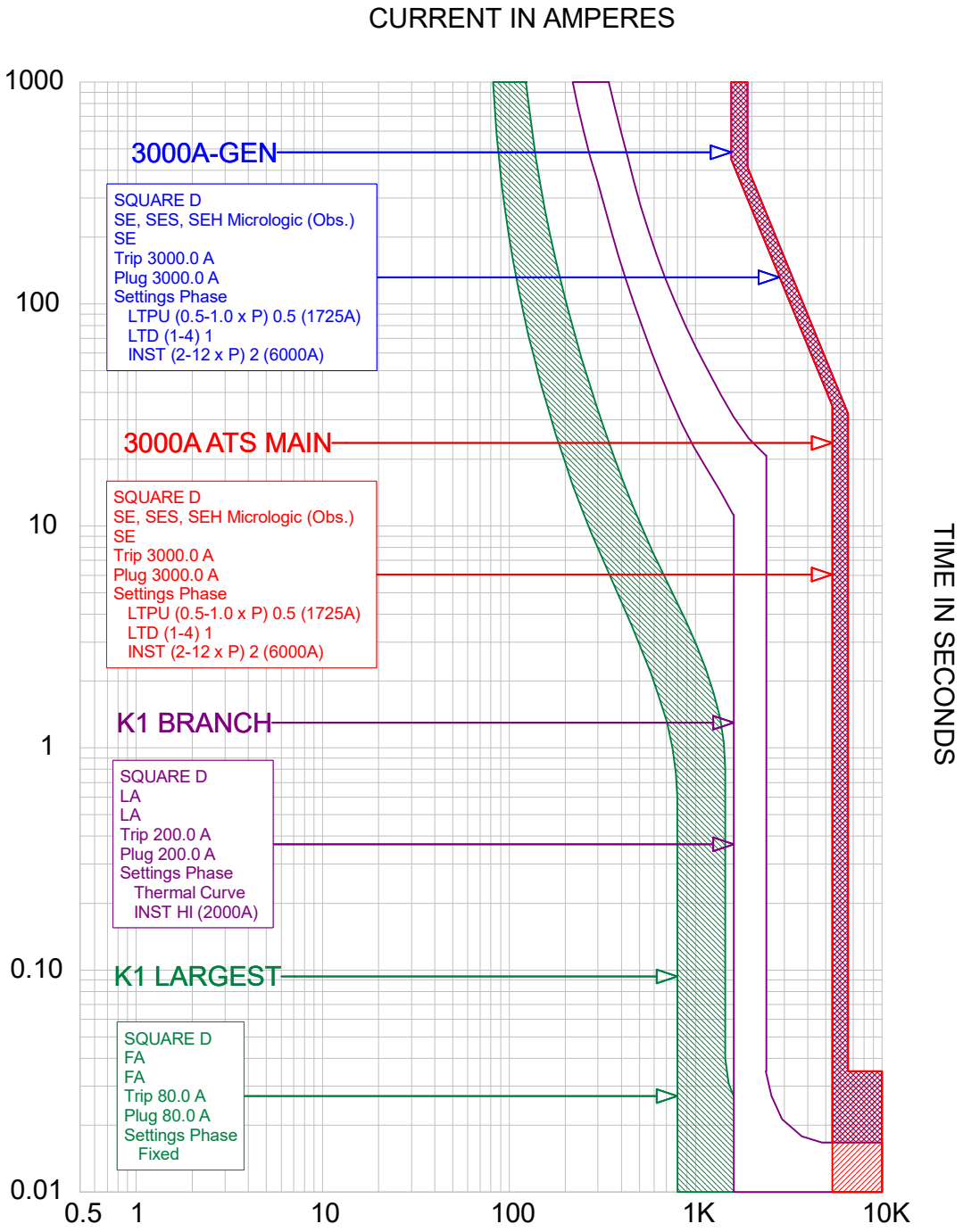
Panel H4.tcc Ref. Voltage: 208V Current in Amps x 1



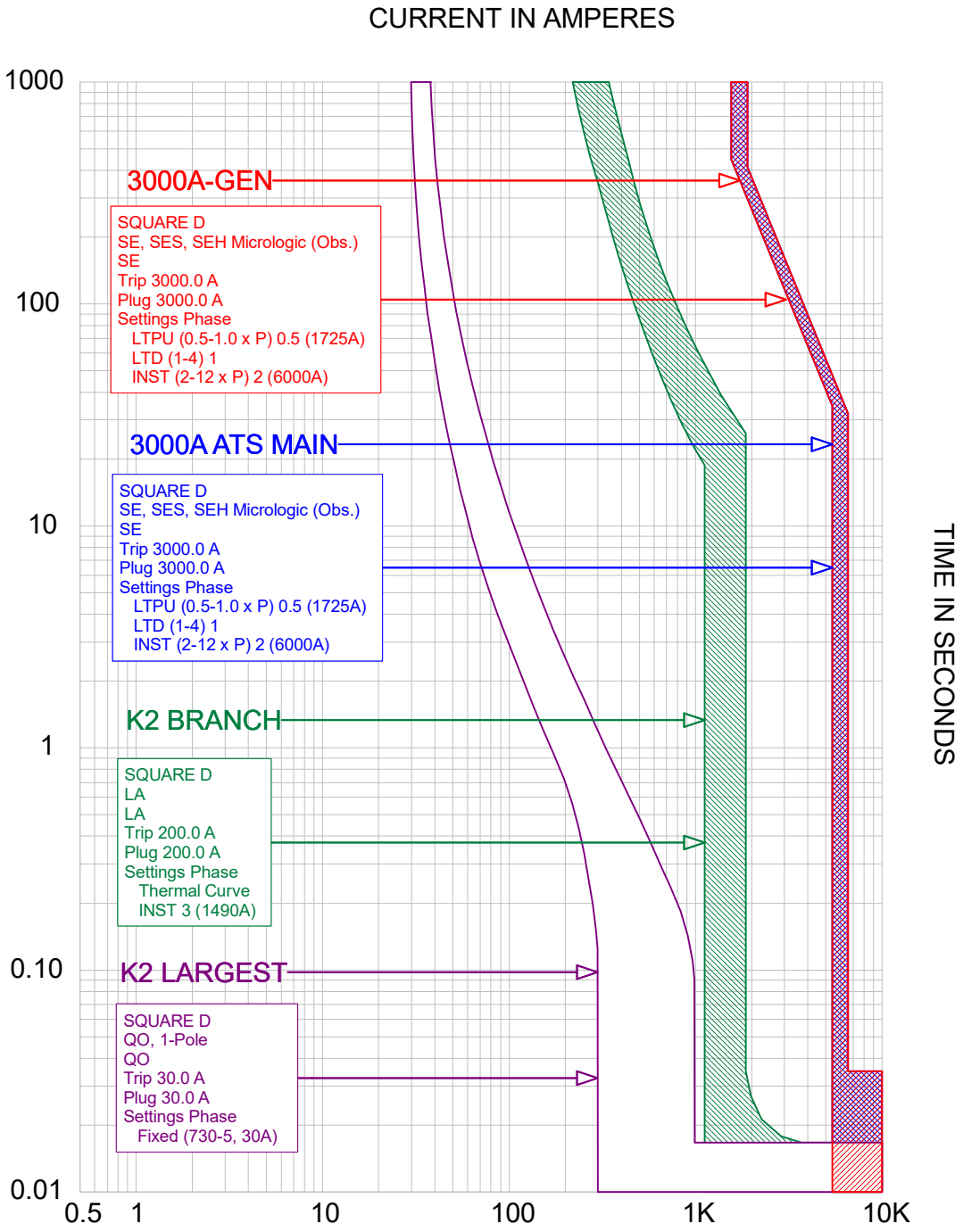
Panel H5.tcc Ref. Voltage: 208V Current in Amps x 1



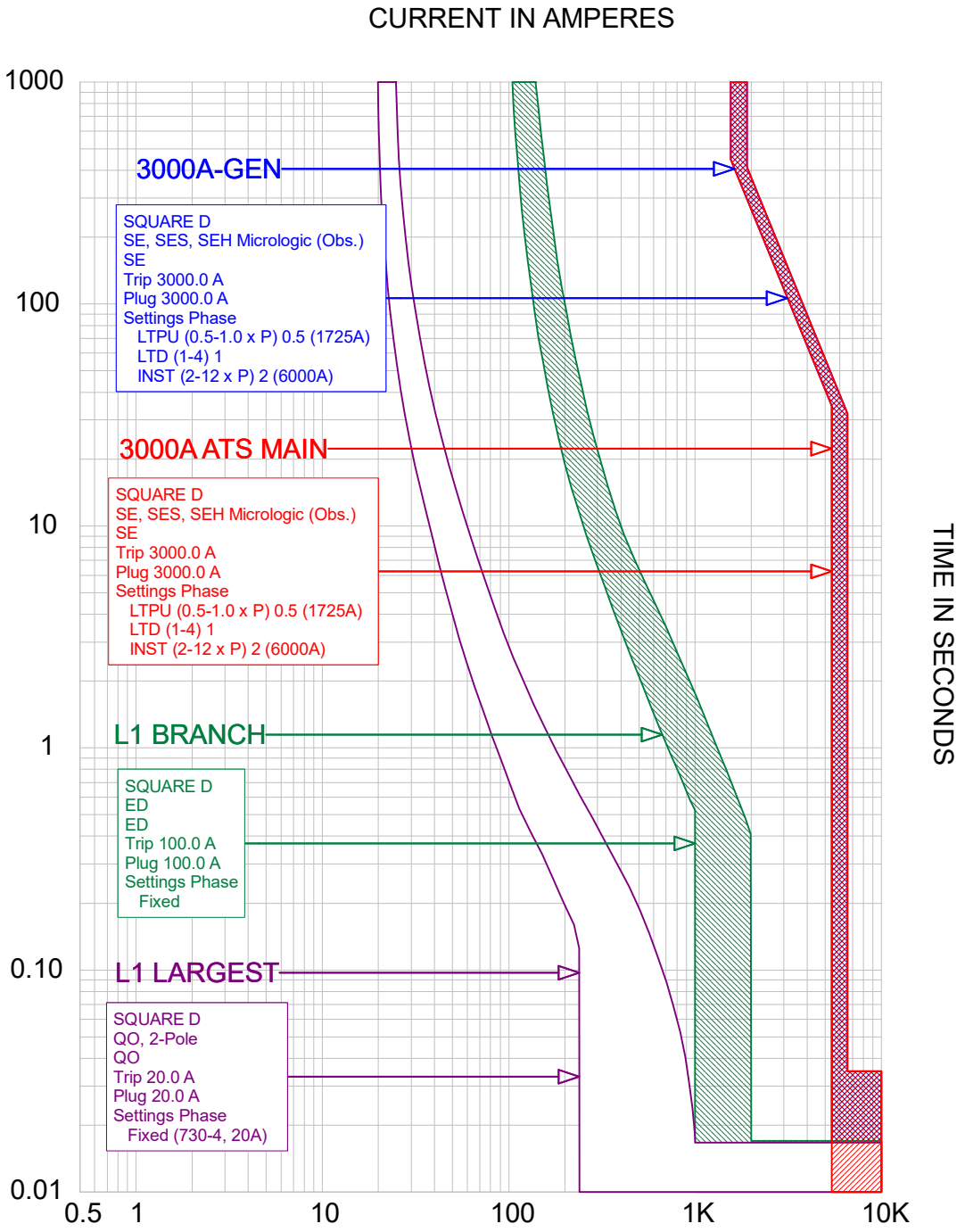
Panel H6.tcc Ref. Voltage: 208V Current in Amps x 1



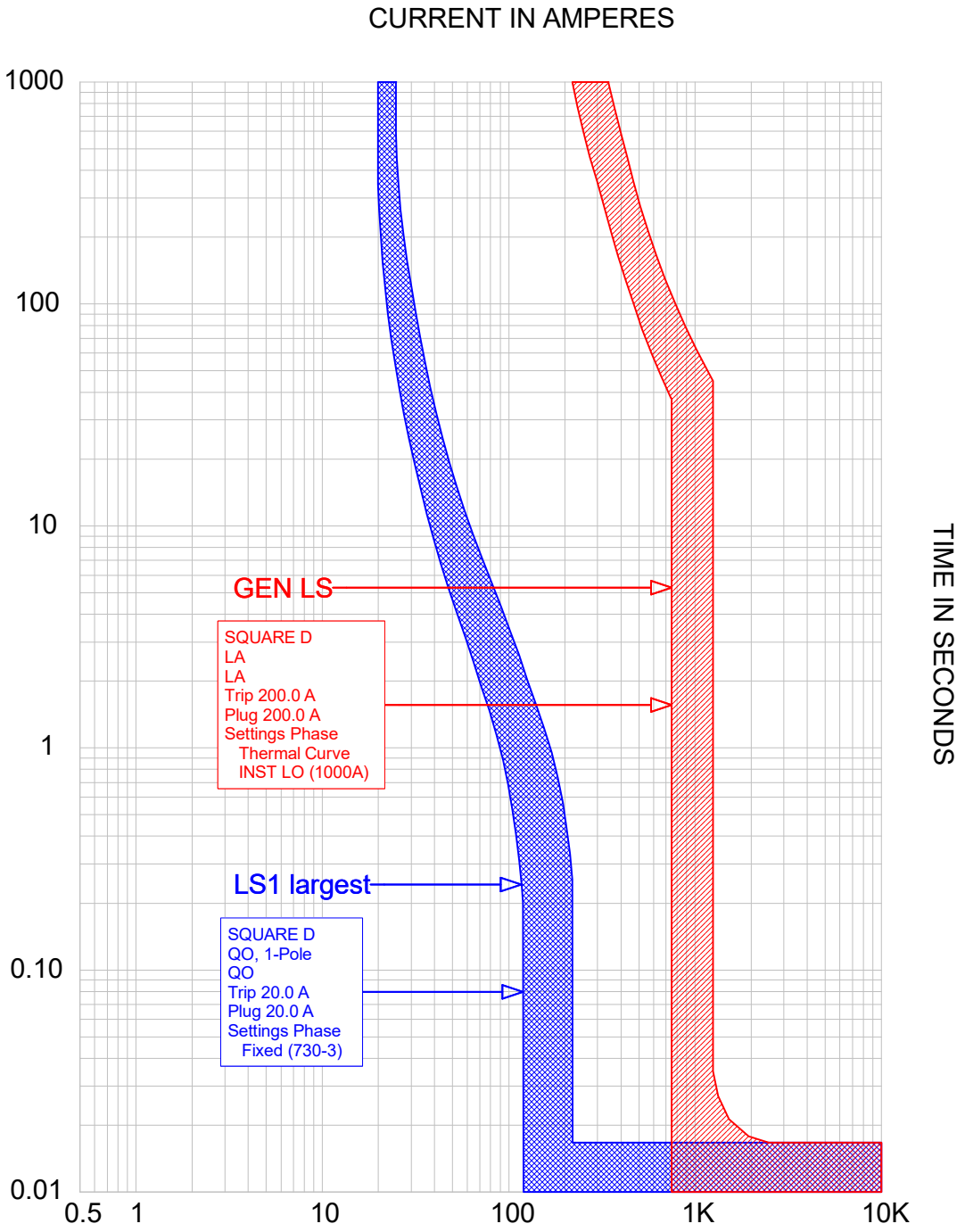
Panel K1.tcc Ref. Voltage: 208V Current in Amps x 1



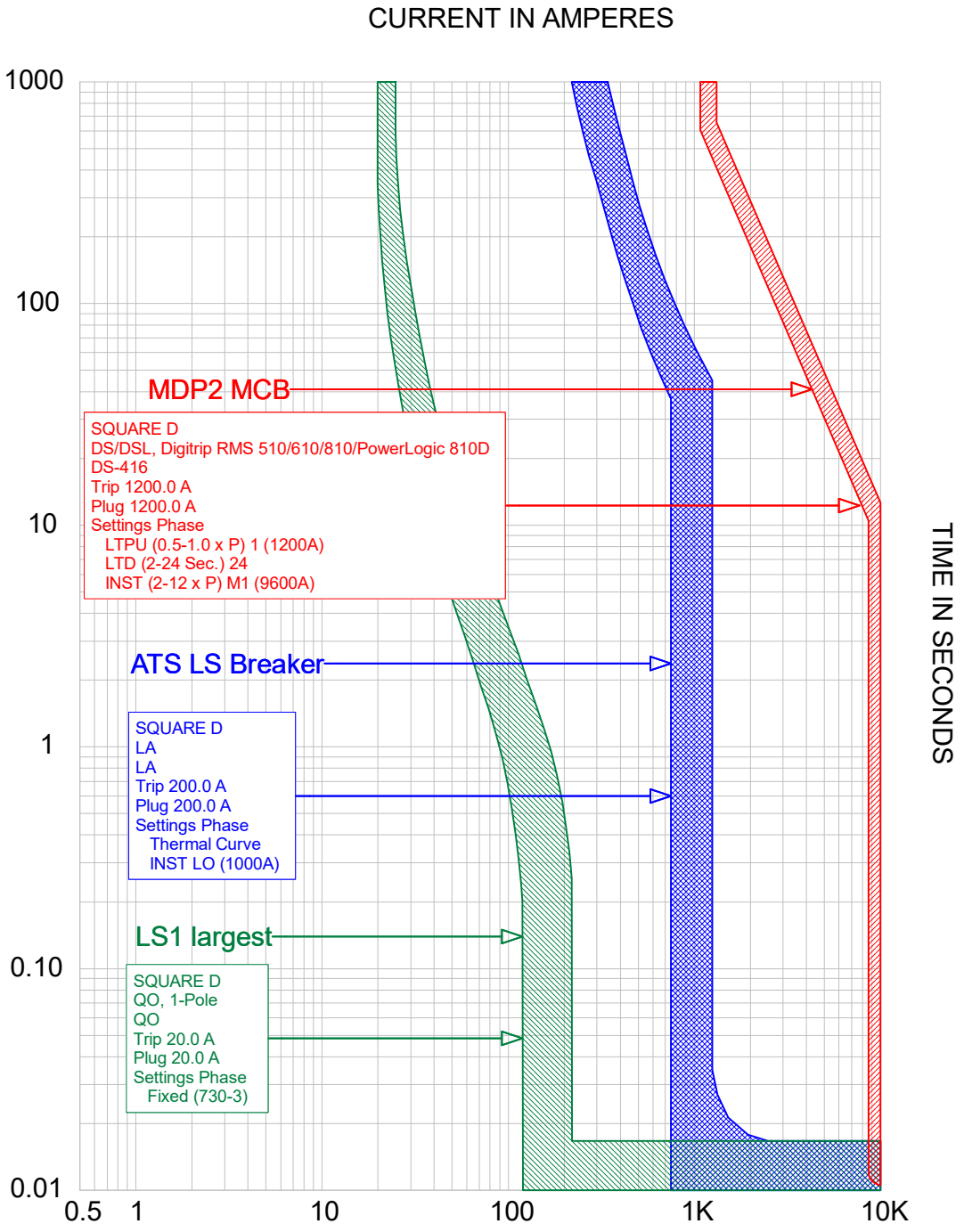
Panel K2.tcc Ref. Voltage: 208V Current in Amps x 1



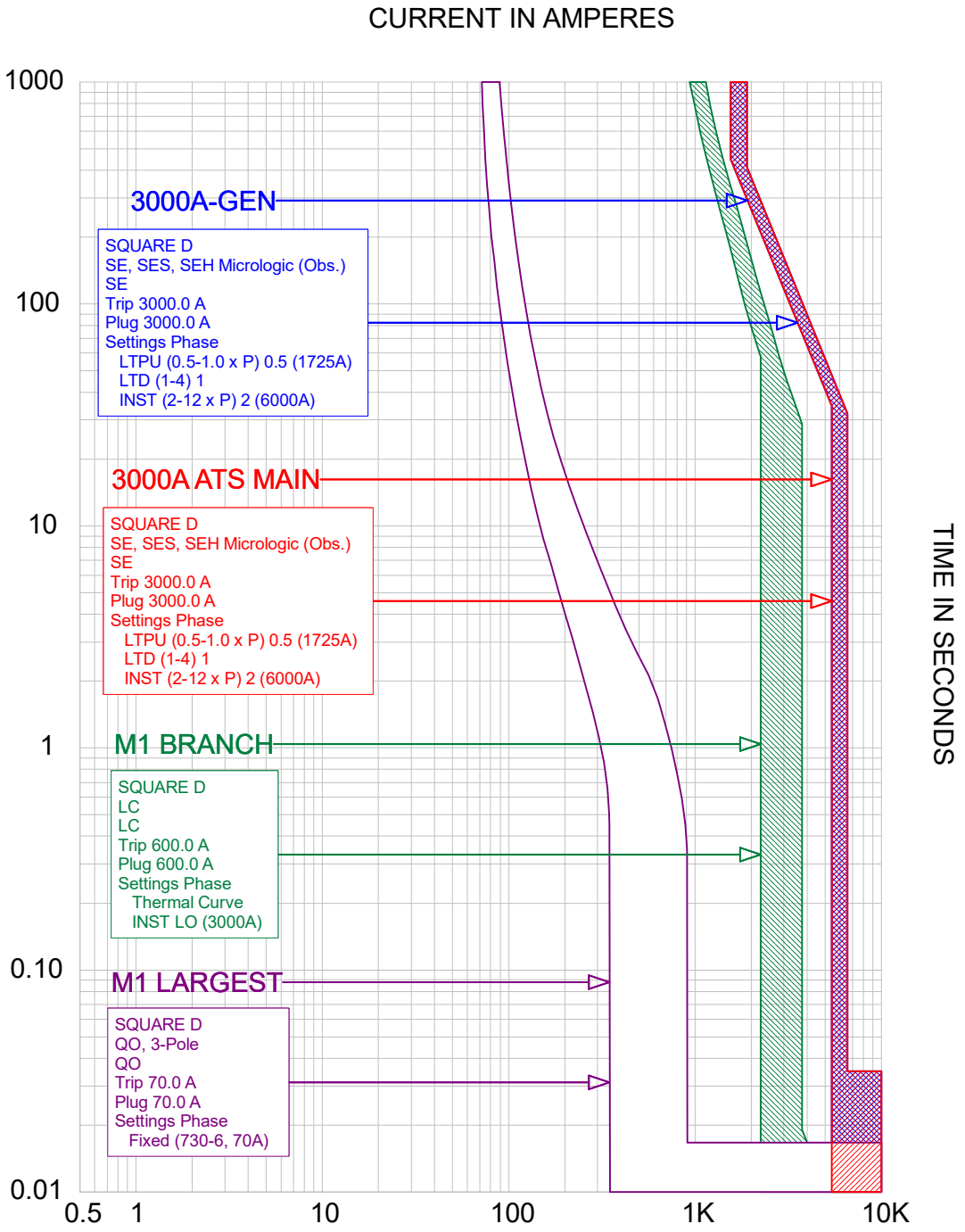
Panel L1.tcc Ref. Voltage: 208V Current in Amps x 1



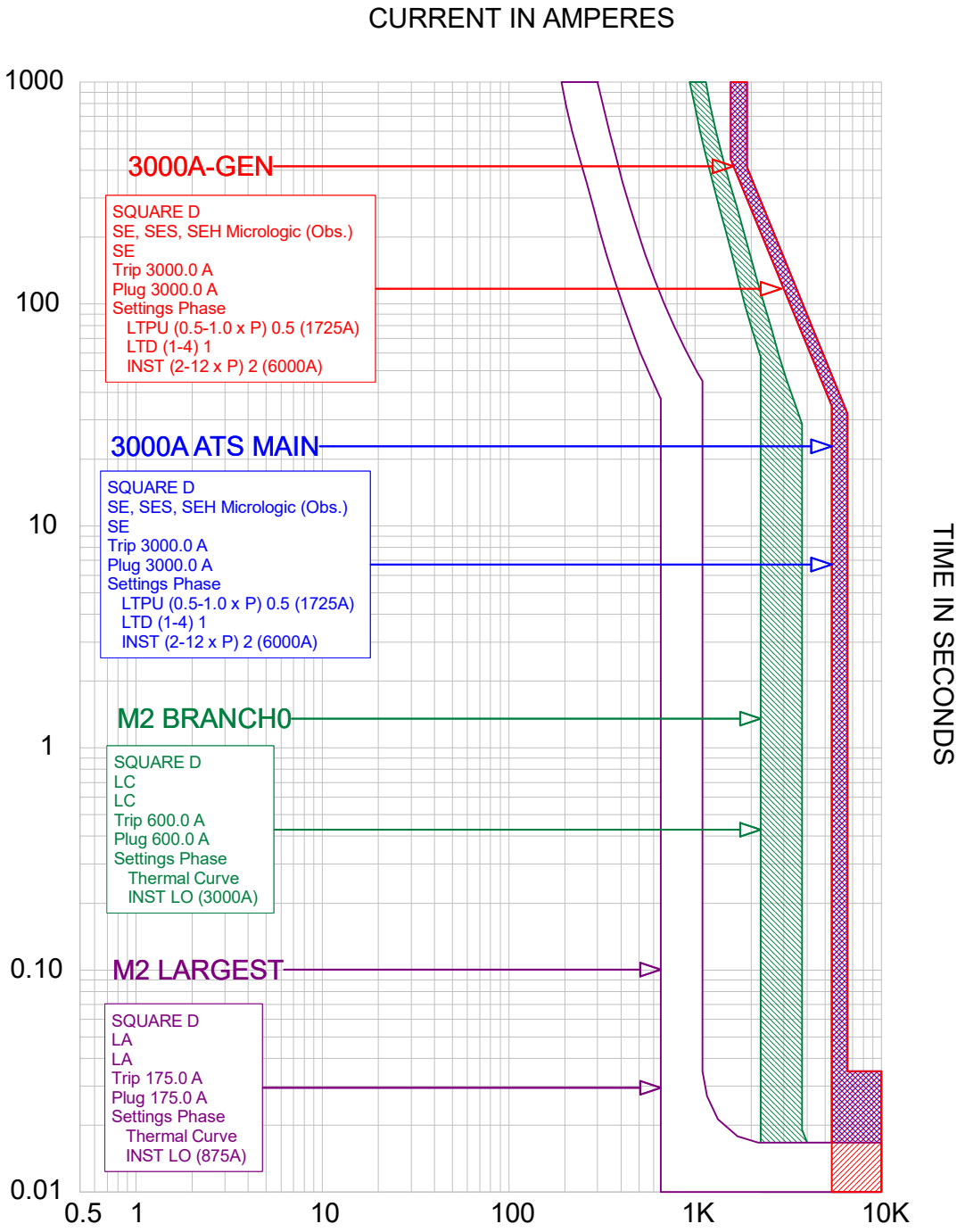
Panel LS1 Emergency.tcc Ref. Voltage: 208V Current in Amps x 1



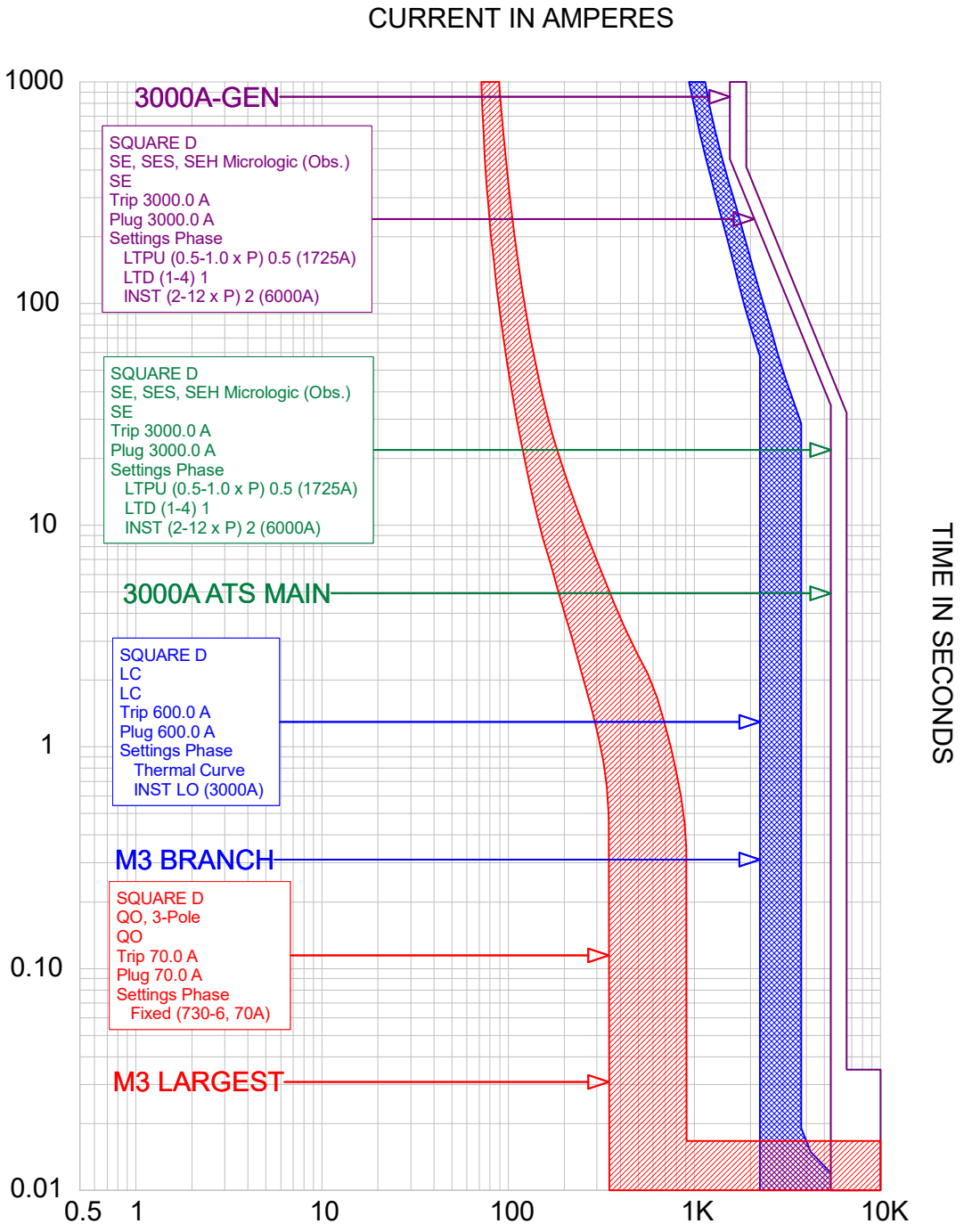
Panel LS1 Normal.tcc Ref. Voltage: 208V Current in Amps x 1



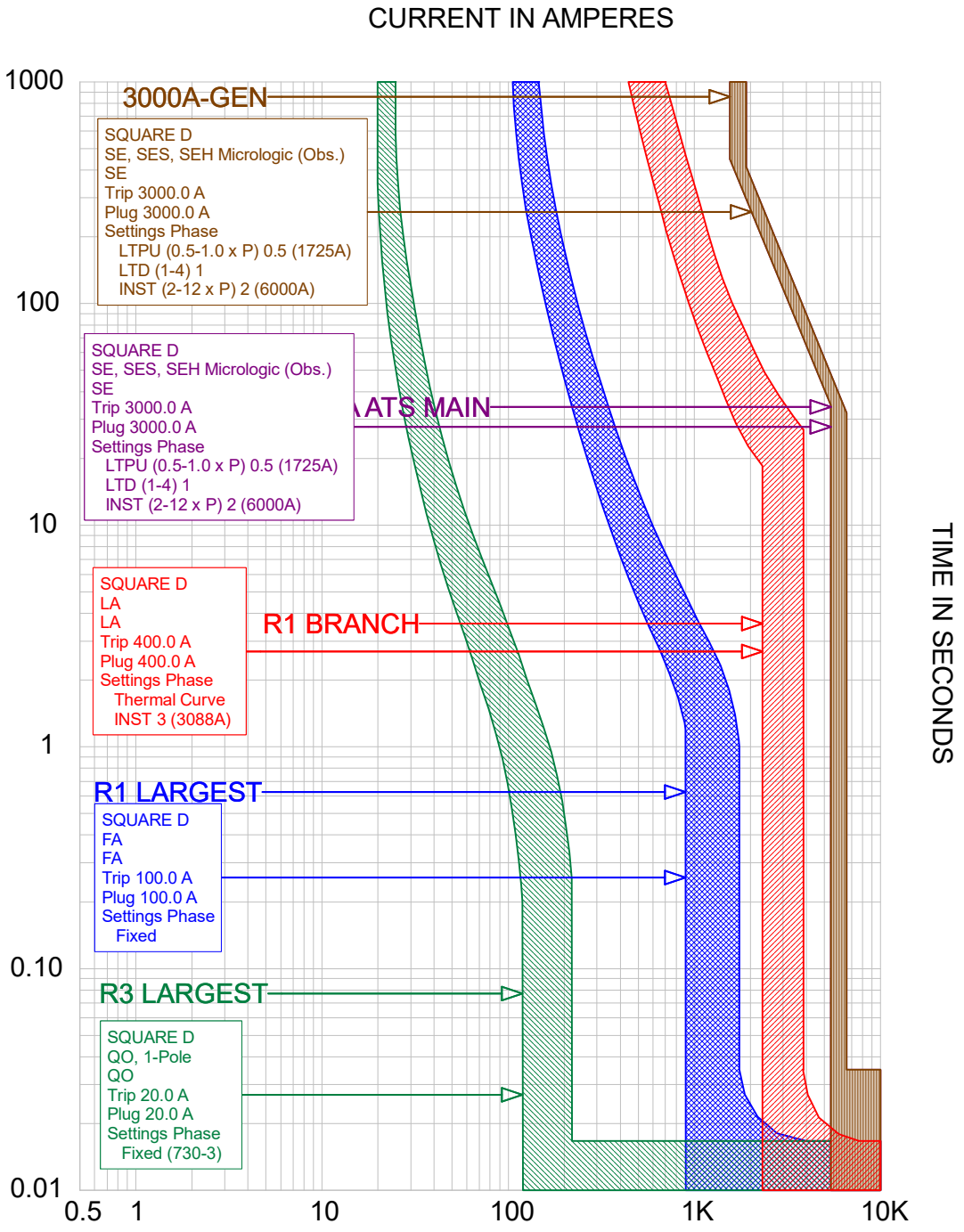
Panel M1.tcc Ref. Voltage: 208V Current in Amps x 1



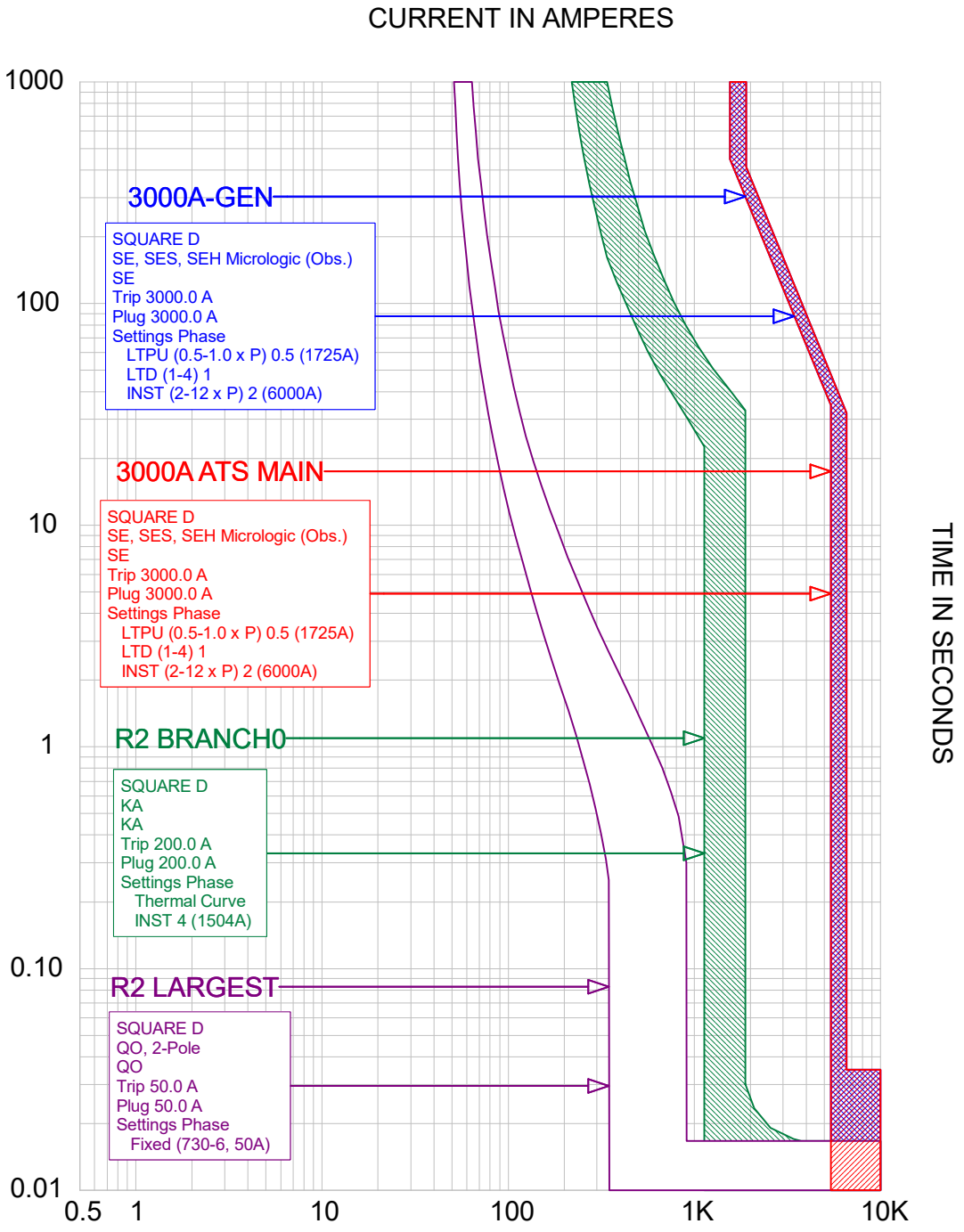
Panel M2.tcc Ref. Voltage: 208V Current in Amps x 1



Panel M3.tcc Ref. Voltage: 208V Current in Amps x 1



Panel R1/R3.tcc Ref. Voltage: 208V Current in Amps x 1



Panel R2.tcc Ref. Voltage: 208V Current in Amps x 1

JENSEN HUGHES
725 Primera Blvd. Suite 215
Lake Mary, FL 32746

HYDRAULIC CALCULATIONS

FOR

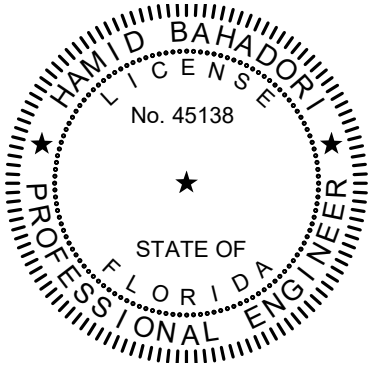
GULFPORT REHAB
REMOTE AREA 1
FOUR RESIDENTIAL SPRINKLERS

FILE NUMBER:
DATE: SEP 30, 2024

-DESIGN DATA-

OCCUPANCY CLASSIFICATION:	LIGHT HAZARD
DENSITY:	.1 gpm/sq. ft.
AREA OF APPLICATION:	4 RESIDENTIAL SPRINKLERS
COVERAGE PER SPRINKLER:	VARIES. ROOM LESS THAN 800 SQ.FT.
NUMBER OF SPRINKLERS CALCULATED:	4 sprinklers
TOTAL SPRINKLER WATER FLOW REQUIRED:	73.9 gpm
TOTAL WATER REQUIRED (including hose):	173.9 gpm
FLOW AND PRESSURE (@ BR2):	73.9 gpm @ 33.3 psi

CALCULATIONS BY HASS COMPUTER PROGRAM (LICENSE # 65847320)
HRS SYSTEMS, INC.



DATE: 9/30/2024CBAKER\HASS88\GULFPORT REHAB FROM TOM COMPUTER\REHAB_1.SDF
JOB TITLE:

WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	@ FLOW (GPM)	AVAIL. PRESS. (PSI)	@ TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
SOURCE	64.0	42.0	1125.0	63.3	173.9	49.4

Available pressure is 13.9 psi (22%) greater than required pressure.

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	173.9 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	0.0 GPM
OTHER HOSE STREAM ALLOWANCES	100.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	73.9 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)
UG2	-4.0	- - - -	51.1	- - -
UG1	-4.0	HOSE STREAM	35.9	100.0
BD	3.0	- - - -	33.0	- - -
BS	3.0	- - - -	48.0	- - -
C1	-4.0	- - - -	35.9	- - -
TR2	24.0	- - - -	23.6	- - -
BR2	2.0	- - - -	33.3	- - -
R1	23.0	K= 5.52	10.6	18.0
R2	23.0	K= 5.52	11.4	18.7
R3	23.0	K= 5.52	10.7	18.1
R4	23.0	K= 5.52	12.0	19.1
A	24.0	- - - -	21.9	- - -
B	24.0	- - - -	22.9	- - -
C	24.0	- - - -	23.5	- - -
D	24.0	- - - -	22.5	- - -
RA	24.0	- - - -	16.9	- - -
RB	24.0	- - - -	17.4	- - -
RC	24.0	- - - -	19.7	- - -
RD	24.0	- - - -	21.7	- - -
Z1	24.0	- - - -	14.5	- - -
Z2	24.0	- - - -	15.5	- - -
Z3	24.0	- - - -	14.9	- - -
Z4	24.0	- - - -	16.2	- - -
SOURCE	0.0	SOURCE	49.4	173.9

DATE: 9/30/2024CBAKER\HASS88\GULFPORT REHAB FROM TOM COMPUTER\REHAB_1.SDF
JOB TITLE:

PIPE DATA

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)		PRESS. SUM. (PSI)
Pipe: 1					-18.0	1.049 PL	10.00	PF	0.8
R1	23.0	5.5	10.6	18.0	6.7	140 FTG	----	PE	0.0
R2	23.0	5.5	11.4	18.7		0.080 TL	10.00	PV	
Pipe: 2					-36.7	1.049 PL	8.75	PF	3.5
R2	23.0	5.5	11.4	18.7	13.6	120 FTG	----	PE	-0.4
Z1	24.0	0.0	14.5	0.0		0.399 TL	8.75	PV	
Pipe: 3					-36.7	1.380 PL	10.00	PF	1.1
Z1	24.0	0.0	14.5	0.0	7.9	120 FTG	----	PE	0.0
Z2	24.0	0.0	15.5	0.0		0.105 TL	10.00	PV	
Pipe: 4					-36.7	1.380 PL	7.00	PF	1.4
Z2	24.0	0.0	15.5	0.0	7.9	120 FTG	T	PE	0.0
RA	24.0	0.0	16.9	0.0		0.105 TL	13.00	PV	
Pipe: 11					-18.1	1.049 PL	11.50	PF	1.2
R3	23.0	5.5	10.7	18.1	6.7	120 FTG	----	PE	0.0
R4	23.0	5.5	12.0	19.1		0.108 TL	11.50	PV	
Pipe: 12					-37.2	1.049 PL	8.25	PF	3.4
R4	23.0	5.5	12.0	19.1	13.8	120 FTG	----	PE	-0.4
Z3	24.0	0.0	14.9	0.0		0.410 TL	8.25	PV	
Pipe: 13					-37.2	1.380 PL	11.50	PF	1.2
Z3	24.0	0.0	14.9	0.0	8.0	120 FTG	----	PE	0.0
Z4	24.0	0.0	16.2	0.0		0.108 TL	11.50	PV	
Pipe: 14					-37.2	1.380 PL	5.83	PF	1.3
Z4	24.0	0.0	16.2	0.0	8.0	120 FTG	T	PE	0.0
RB	24.0	0.0	17.4	0.0		0.108 TL	11.83	PV	
Pipe: 100					-36.7	1.610 PL	10.50	PF	0.5
RA	24.0	0.0	16.9	0.0	5.8	120 FTG	----	PE	0.0
RB	24.0	0.0	17.4	0.0		0.050 TL	10.50	PV	
Pipe: 101					-73.9	1.610 PL	12.50	PF	2.3
RB	24.0	0.0	17.4	0.0	11.6	120 FTG	----	PE	0.0
RC	24.0	0.0	19.7	0.0		0.181 TL	12.50	PV	
Pipe: 102					-73.9	1.610 PL	3.00	PF	2.0
RC	24.0	0.0	19.7	0.0	11.6	120 FTG	T	PE	0.0
RD	24.0	0.0	21.7	0.0		0.181 TL	11.00	PV	
Pipe: 1000					-34.6	2.635 PL	40.16	PF	0.2
RD	24.0	0.0	21.7	0.0	2.0	120 FTG	T	PE	0.0
A	24.0	0.0	21.9	0.0		0.004 TL	57.16	PV	
Pipe: 1001					-34.6	2.635 PL	186.55	PF	1.0
A	24.0	0.0	21.9	0.0	2.0	120 FTG	4ET	PE	0.0
B	24.0	0.0	22.9	0.0		0.004 TL	235.55	PV	

DATE: 9/30/2024CBAKER\HASS88\GULFPORT REHAB FROM TOM COMPUTER\REHAB_1.SDF
JOB TITLE:

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)		PRESS. SUM. (PSI)
Pipe: 1002					-34.6	2.635 PL	135.00	PF	0.6
B	24.0	0.0	22.9	0.0	2.0	120 FTG	2E	PE	0.0
C	24.0	0.0	23.5	0.0		0.004 TL	151.00	PV	
Pipe: 1003					39.3	2.635 PL	160.30	PF	1.0
C	24.0	0.0	23.5	0.0	2.3	120 FTG	2T	PE	0.0
D	24.0	0.0	22.5	0.0		0.005 TL	194.30	PV	
Pipe: 1004					39.3	2.635 PL	124.50	PF	0.8
D	24.0	0.0	22.5	0.0	2.3	120 FTG	4E	PE	0.0
RD	24.0	0.0	21.7	0.0		0.005 TL	156.50	PV	
Pipe: 2000					-73.9	4.260 PL	48.00	PF	0.2
C	24.0	0.0	23.5	0.0	1.7	120 FTG	4E	PE	0.0
TR2	24.0	0.0	23.6	0.0		0.002 TL	100.00	PV	
Pipe: 3000					73.9	4.260 PL	22.00	PF	0.1
BR2	2.0	0.0	33.3	0.0	1.7	120 FTG	TCG	PE	-9.5
TR2	24.0	0.0	23.6	0.0		0.002 TL	80.00	PV	
Pipe: 3001					-73.9	6.280 PL	15.00	PF	0.0
BR2	2.0	0.0	33.3	0.0	0.8	140 FTG	E	PE	2.6
C1	-4.0	0.0	35.9	0.0		0.000 TL	37.00	PV	
Pipe: 5000					-73.9	6.280 PL	28.00	PF	0.0
C1	-4.0	0.0	35.9	0.0	0.8	140 FTG	T	PE	0.0
UG1	-4.0	H.S.	35.9	100.0		0.000 TL	75.00	PV	
Pipe: 5001					-173.9	8.390 PL	388.50	PF	0.1
UG1	-4.0	H.S.	35.9	100.0	1.0	140 FTG	5E2G	PE	-3.0
BD	3.0	0.0	33.0	0.0		0.000 TL	557.50	PV	
Pipe: 5002					FIXED PRESSURE LOSS DEVICE				
BS	3.0	0.0	48.0	0.0	15.0 psi, 173.9 gpm				
BD	3.0	0.0	33.0	0.0					
Pipe: 5003					-173.9	8.390 PL	48.00	PF	0.0
BS	3.0	0.0	48.0	0.0	1.0	140 FTG	3ETG	PE	3.0
UG2	-4.0	0.0	51.1	0.0		0.000 TL	207.00	PV	
Pipe: 5004					-173.9	12.460 PL	500.00	PF	0.0
UG2	-4.0	0.0	51.1	0.0	0.5	140 FTG	----	PE	-1.7
SOURCE	0.0	SRCE	49.4	(N/A)		0.000 TL	500.00	PV	

NOTES (HASS):

(1) Calculations were performed by the HASS 2023 D computer program
in accordance with NFPA (2020)
under license no. 65847320 granted by
HRS Systems, Inc.
208 Southside Square
Petersburg, TN 37144
(931) 659-9760

(2) The system has been calculated to provide an average imbalance at each node of 0.008 gpm and a maximum imbalance at any node of 0.184 gpm.

(3) Total pressure at each node is used in balancing the system. Maximum water velocity is 13.8 ft/sec at pipe 12.

(4) Items listed in bold print on the cover sheet

are automatically transferred from the calculation report.

(5) Available pressure at source node SOURCE under full flow conditions is 63.15 psi with a flow of 193.34 gpm.

(6) PIPE FITTINGS TABLE

HASS Pipe Table Name: standard

PAGE: A MATERIAL: S40 HWC: 120

Diameter (in)	Equivalent Fitting Lengths in Feet								
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	A AlmChk	D DPVlv	N NTee
	F F45Ell								
1.049	2.00 1.00	5.00	2.00	5.00	6.00	1.00	10.00	2.00	5.00
1.380	3.00 1.50	6.00	2.00	7.00	6.00	1.00	10.00	10.00	6.00
1.610	4.00 2.00	8.00	2.00	9.00	6.00	1.00	10.00	10.00	8.00

PAGE: B MATERIAL: THNWL HWC: 120

Diameter (in)	Equivalent Fitting Lengths in Feet								
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	A AlmChk	D DPVlv	NP NTee
	F F45Ell								
2.635	8.00 4.00	17.00	6.00	19.00	10.00	1.00	14.00	14.00	17.00
4.260	13.00 6.50	26.00	8.00	29.00	16.00	3.00	26.00	26.00	26.00

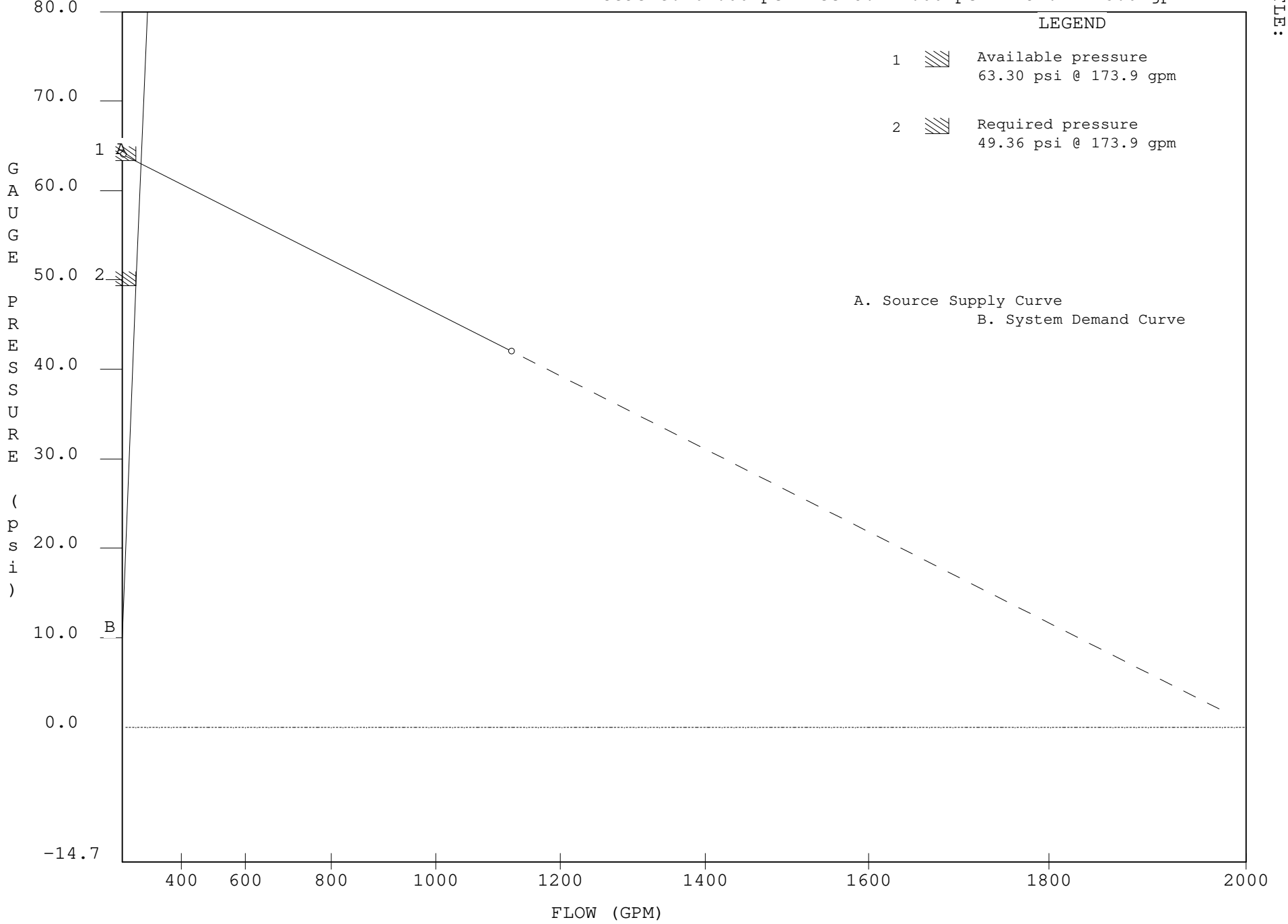
DATE: 9/30/2024CBAKER\HASS88\GULFPORT REHAB FROM TOM COMPUTER\REHAB_1.SDF
JOB TITLE:

PAGE: D MATERIAL: DIRON HWC: 140

Diameter (in)	Equivalent Fitting Lengths in Feet							
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	N NPTee	F 45Ell
6.280	22.00	47.00	14.00	51.00	16.00	5.00	47.00	11.00
8.390	31.00	59.00	22.00	76.00	20.00	7.00	59.00	15.50
12.460	44.00	98.00	30.00	107.00	34.00	10.00	98.00	22.00

WATER SUPPLY ANALYSIS

Static: 64.00 psi Resid: 42.00 psi Flow: 1125.0 gpm

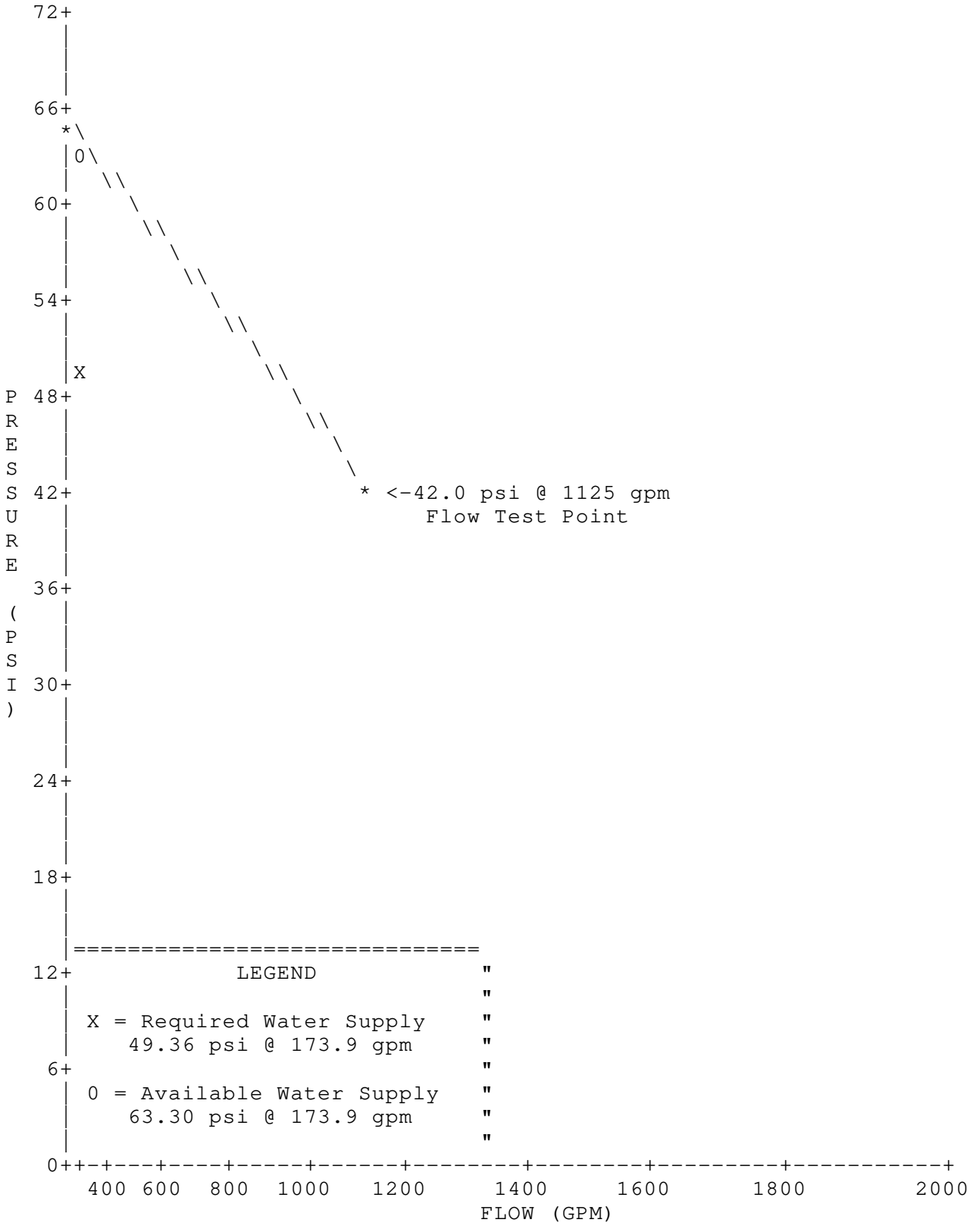


Dashed Lines indicate extrapolated values from Test Results

Site pressures are based on hose stream deduction at the source

DATE: 9/30/2024CBAKER\HASS88\GULFPORT REHAB FROM TOM COMPUTER\REHAB_1.SDF
JOB TITLE:

WATER SUPPLY CURVE



Utility Report:

Equivalent K-Factor Calculator

Node Name	Sprinkler K-Factor	Pres. (psi)	Dia. (in)	Pipe Len.(ft)	Ftgs.	Total Len.(ft)	H-W coef.	Equivalent K-factor
5.8 arm	5.80	9.60	1.049	2.50	ET	9.50	120.00	5.52

Equivalent K-Factor Calculator

Node Name	Sprinkler K-Factor	Pres. (psi)	Dia. (in)	Pipe Len.(ft)	Ftgs.	Total Len.(ft)	H-W coef.	Equivalent K-factor
5.8 16x16	5.80	7.60	1.049	2.50	ET	9.50	120.00	5.51

Equivalent K-Factor Calculator

Node Name	Sprinkler K-Factor	Pres. (psi)	Dia. (in)	Pipe Len.(ft)	Ftgs.	Total Len.(ft)	H-W coef.	Equivalent K-factor
4.9 12x12	4.90	7.00	1.049	2.50	ET	9.50	120.00	4.72

JENSEN HUGHES
725 Primera Blvd. Suite 215
Lake Mary, FL 32746

HYDRAULIC CALCULATIONS

FOR

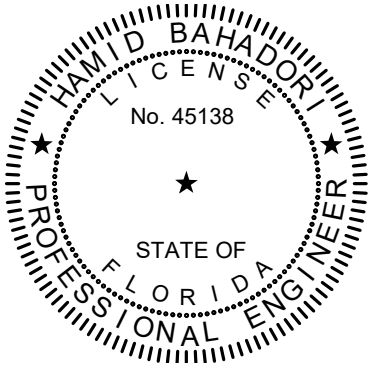
GULFPORT REHAB
REMOTE AREA 2
ORDINARY HAZARD GROUP 1

FILE NUMBER:
DATE: AUG 2, 2024

-DESIGN DATA-

OCCUPANCY CLASSIFICATION:	ORDINARY HAZARD GROUP 1
DENSITY:	.15 gpm/sq. ft.
AREA OF APPLICATION:	900 sq. ft. (REDUCED FOR QR)
COVERAGE PER SPRINKLER:	100-120 sq. ft.
NUMBER OF SPRINKLERS CALCULATED:	13 sprinklers
TOTAL SPRINKLER WATER FLOW REQUIRED:	224.0 gpm
TOTAL WATER REQUIRED (including hose):	474.1 gpm
FLOW AND PRESSURE (@ BR):	224 gpm @ 35 psi

CALCULATIONS BY HASS COMPUTER PROGRAM (LICENSE # 65847320)
HRS SYSTEMS, INC.



DATE: 8/2/2024\CBAKER\DOCUMENTS\HASSDATA\GULFPORT REHAB\REHAB_OH1_RA2.SDF
JOB TITLE:

WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	@ FLOW (GPM)	AVAIL. PRESS. (PSI)	@ TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
SOURCE	64.0	42.0	1125.0	59.6	474.1	52.1

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	474.1 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	0.0 GPM
OTHER HOSE STREAM ALLOWANCES	250.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	224.1 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)
UG2	-4.0	- - - -	53.8	- - -
UG1	-4.0	HOSE STREAM	37.7	250.0
BD	3.0	- - - -	35.4	- - -
BS	3.0	- - - -	50.4	- - -
C1	-4.0	- - - -	37.6	- - -
TR2	24.0	- - - -	24.4	- - -
BR2	2.0	- - - -	35.0	- - -
K1	24.0	K= 5.40	7.7	15.0
K2	24.0	K= 5.40	8.3	15.5
K3	24.0	K= 5.40	9.0	16.2
K4	24.0	K= 5.40	10.3	17.4
K5	24.0	K= 5.34	7.9	15.0
K6	24.0	K= 5.34	8.5	15.5
K7	24.0	K= 5.34	9.4	16.3
K8	24.0	K= 5.40	11.7	18.5
K9	24.0	K= 5.40	10.9	17.8
KA	24.0	- - - -	10.9	- - -
KB	24.0	- - - -	11.3	- - -
KC	24.0	- - - -	12.0	- - -
KD	24.0	- - - -	15.8	- - -
S1	24.0	K= 5.40	11.8	18.5
S2	24.0	K= 5.40	12.9	19.4
S3	24.0	K= 5.34	12.2	18.7
S4	24.0	K= 5.40	14.0	20.2
SA	24.0	- - - -	15.8	- - -
SB	24.0	- - - -	15.9	- - -
SC	24.0	- - - -	17.1	- - -
A	24.0	- - - -	18.9	- - -
B	24.0	- - - -	21.5	- - -
C	24.0	- - - -	23.2	- - -
D	24.0	- - - -	16.5	- - -
RD	24.0	- - - -	18.2	- - -
Z5	24.0	- - - -	14.7	- - -
SOURCE	0.0	SOURCE	52.1	474.1

DATE: 8/2/2024\CBAKER\DOCUMENTS\HASSDATA\GULFPORT REHAB\REHAB_OH1_RA2.SDF
JOB TITLE:

PIPE DATA

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)		PRESS. SUM. (PSI)
Pipe: 1					-15.0	1.049 PL	10.00	PF	0.6
K1	24.0	5.4	7.7	15.0	5.6	140 FTG	----	PE	0.0
K2	24.0	5.4	8.3	15.5		0.057 TL	10.00	PV	
Pipe: 2					-30.5	1.380 PL	10.00	PF	0.7
K2	24.0	5.4	8.3	15.5	6.6	120 FTG	----	PE	0.0
K3	24.0	5.4	9.0	16.2		0.075 TL	10.00	PV	
Pipe: 3					-46.8	1.380 PL	5.50	PF	1.9
K3	24.0	5.4	9.0	16.2	10.0	120 FTG	T	PE	0.0
KA	24.0	0.0	10.9	0.0		0.165 TL	11.50	PV	
Pipe: 4					-17.4	1.049 PL	1.00	PF	0.6
K4	24.0	5.4	10.3	17.4	6.4	120 FTG	T	PE	0.0
KA	24.0	0.0	10.9	0.0		0.100 TL	6.00	PV	
Pipe: 5					-15.0	1.049 PL	8.00	PF	0.6
K5	24.0	5.3	7.9	15.0	5.6	120 FTG	----	PE	0.0
K6	24.0	5.3	8.5	15.5		0.076 TL	8.00	PV	
Pipe: 6					-30.5	1.380 PL	12.00	PF	0.9
K6	24.0	5.3	8.5	15.5	6.5	120 FTG	----	PE	0.0
K7	24.0	5.3	9.4	16.3		0.075 TL	12.00	PV	
Pipe: 7					-46.8	1.380 PL	5.66	PF	1.9
K7	24.0	5.3	9.4	16.3	10.0	120 FTG	T	PE	0.0
KB	24.0	0.0	11.3	0.0		0.165 TL	11.66	PV	
Pipe: 8					-17.8	1.049 PL	5.67	PF	1.1
K9	24.0	5.4	10.9	17.8	6.6	120 FTG	T	PE	0.0
KC	24.0	0.0	12.0	0.0		0.105 TL	10.67	PV	
Pipe: 9					-64.1	2.067 PL	8.50	PF	0.4
KA	24.0	0.0	10.9	0.0	6.1	120 FTG	----	PE	0.0
KB	24.0	0.0	11.3	0.0		0.041 TL	8.50	PV	
Pipe: 10					-111.0	2.067 PL	3.50	PF	0.4
KB	24.0	0.0	11.3	0.0	10.6	120 FTG	----	PE	0.0
K8	24.0	5.4	11.7	18.5		0.114 TL	3.50	PV	
Pipe: 11					-129.4	2.067 PL	2.00	PF	0.3
K8	24.0	5.4	11.7	18.5	12.4	120 FTG	----	PE	0.0
KC	24.0	0.0	12.0	0.0		0.151 TL	2.00	PV	
Pipe: 12					-147.2	2.067 PL	10.10	PF	3.9
KC	24.0	0.0	12.0	0.0	14.1	120 FTG	T	PE	0.0
KD	24.0	0.0	15.8	0.0		0.192 TL	20.10	PV	
Pipe: 13					-18.5	1.049 PL	10.00	PF	1.1
S1	24.0	5.4	11.8	18.5	6.9	120 FTG	----	PE	0.0
S2	24.0	5.4	12.9	19.4		0.113 TL	10.00	PV	

DATE: 8/2/2024\CBAKER\DOCUMENTS\HASSDATA\GULFPORT REHAB\REHAB_OH1_RA2.SDF
JOB TITLE:

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)		PRESS. SUM. (PSI)
Pipe: 14					-37.9	1.380 PL	14.00	PF	2.9
S2	24.0	5.4	12.9	19.4	8.1	120 FTG	2ET	PE	0.0
SA	24.0	0.0	15.8	0.0		0.112 TL	26.00	PV	
Pipe: 15					-18.7	1.049 PL	11.25	PF	1.7
S3	24.0	5.3	12.2	18.7	6.9	120 FTG	2E	PE	0.0
S4	24.0	5.4	14.0	20.2		0.115 TL	15.25	PV	
Pipe: 16					-38.9	1.380 PL	6.00	PF	0.7
S4	24.0	5.4	14.0	20.2	8.3	120 FTG	----	PE	0.0
Z5	24.0	0.0	14.7	0.0		0.117 TL	6.00	PV	
Pipe: 17					-38.9	1.380 PL	4.25	PF	1.2
Z5	24.0	0.0	14.7	0.0	8.3	120 FTG	T	PE	0.0
SB	24.0	0.0	15.9	0.0		0.117 TL	10.25	PV	
Pipe: 18					-37.9	2.067 PL	6.16	PF	0.1
SA	24.0	0.0	15.8	0.0	3.6	120 FTG	----	PE	0.0
SB	24.0	0.0	15.9	0.0		0.016 TL	6.16	PV	
Pipe: 19					-76.8	2.067 PL	10.25	PF	1.2
SB	24.0	0.0	15.9	0.0	7.3	120 FTG	T	PE	0.0
SC	24.0	0.0	17.1	0.0		0.058 TL	20.25	PV	
Pipe: 1000					-60.1	2.635 PL	40.16	PF	0.6
RD	24.0	0.0	18.2	0.0	3.5	120 FTG	T	PE	0.0
A	24.0	0.0	18.9	0.0		0.011 TL	57.16	PV	
Pipe: 1001					-60.1	2.635 PL	186.55	PF	2.6
A	24.0	0.0	18.9	0.0	3.5	120 FTG	4ET	PE	0.0
B	24.0	0.0	21.5	0.0		0.011 TL	235.55	PV	
Pipe: 1002					-60.1	2.635 PL	135.00	PF	1.7
B	24.0	0.0	21.5	0.0	3.5	120 FTG	2E	PE	0.0
C	24.0	0.0	23.2	0.0		0.011 TL	151.00	PV	
Pipe: 1002A					163.9	2.635 PL	68.50	PF	6.1
C	24.0	0.0	23.2	0.0	9.6	120 FTG	T	PE	0.0
SC	24.0	0.0	17.1	0.0		0.072 TL	85.50	PV	
Pipe: 1002B					87.2	2.635 PL	54.00	PF	1.2
SC	24.0	0.0	17.1	0.0	5.1	120 FTG	----	PE	0.0
KD	24.0	0.0	15.8	0.0		0.022 TL	54.00	PV	
Pipe: 1002C					-60.1	2.635 PL	37.75	PF	0.6
KD	24.0	0.0	15.8	0.0	3.5	120 FTG	T	PE	0.0
D	24.0	0.0	16.5	0.0		0.011 TL	54.75	PV	
Pipe: 1004					-60.1	2.635 PL	124.50	PF	1.8
D	24.0	0.0	16.5	0.0	3.5	120 FTG	4E	PE	0.0
RD	24.0	0.0	18.2	0.0		0.011 TL	156.50	PV	

DATE: 8/2/2024\CBAKER\DOCUMENTS\HASSDATA\GULFPORT REHAB\REHAB_OH1_RA2.SDF
JOB TITLE:

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)		PRESS. SUM. (PSI)	
Pipe: 2000					-224.0	4.260 PL	48.00	PF	1.2	
C	24.0	0.0	23.2	0.0	5.0	120 FTG	4E	PE	0.0	
TR2	24.0	0.0	24.4	0.0		0.012 TL	100.00	PV		
Pipe: 3000					224.0	4.260 PL	22.00	PF	1.0	
BR2	2.0	0.0	35.0	0.0	5.0	120 FTG	TCG	PE	-9.5	
TR2	24.0	0.0	24.4	0.0		0.012 TL	80.00	PV		
Pipe: 3001					-224.0	6.280 PL	15.00	PF	0.1	
BR2	2.0	0.0	35.0	0.0	2.3	140 FTG	E	PE	2.6	
C1	-4.0	0.0	37.6	0.0		0.001 TL	37.00	PV		
Pipe: 5000					-224.0	6.280 PL	28.00	PF	0.1	
C1	-4.0	0.0	37.6	0.0	2.3	140 FTG	T	PE	0.0	
UG1	-4.0	H.S.	37.7	250.0		0.001 TL	75.00	PV		
Pipe: 5001					-474.0	8.390 PL	388.50	PF	0.8	
UG1	-4.0	H.S.	37.7	250.0	2.8	140 FTG	5E2G	PE	-3.0	
BD	3.0	0.0	35.4	0.0		0.001 TL	557.50	PV		
Pipe: 5002					FIXED PRESSURE LOSS DEVICE					
BS	3.0	0.0	50.4	0.0	15.0 psi, 474.0 gpm					
BD	3.0	0.0	35.4	0.0						
Pipe: 5003					-474.0	8.390 PL	48.00	PF	0.3	
BS	3.0	0.0	50.4	0.0	2.8	140 FTG	3ETG	PE	3.0	
UG2	-4.0	0.0	53.8	0.0		0.001 TL	207.00	PV		
Pipe: 5004					-474.1	12.460 PL	500.00	PF	0.1	
UG2	-4.0	0.0	53.8	0.0	1.2	140 FTG	----	PE	-1.7	
SOURCE	0.0	SRCE	52.1	(N/A)		0.000 TL	500.00	PV		

NOTES (HASS):

(1) Calculations were performed by the HASS 2023 D computer program in accordance with NFPA (2020) under license no. 65847320 granted by

HRS Systems, Inc.
208 Southside Square
Petersburg, TN 37144
(931) 659-9760

(2) The system has been calculated to provide an average imbalance at each node of 0.003 gpm and a maximum imbalance at any node of 0.113 gpm.

(3) Total pressure at each node is used in balancing the system. Maximum water velocity is 14.1 ft/sec at pipe 12.

(4) Items listed in bold print on the cover sheet

are automatically transferred from the calculation report.

(5) Available pressure at source node SOURCE under full flow conditions is 59.03 psi with a flow of 503.32 gpm.

(6) PIPE FITTINGS TABLE

HASS Pipe Table Name: standard

PAGE: A MATERIAL: S40 HWC: 120

Diameter (in)	Equivalent Fitting Lengths in Feet								
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	A AlmChk	D DPVlv	N NTee
	F F45Ell								
1.049	2.00 1.00	5.00	2.00	5.00	6.00	1.00	10.00	2.00	5.00
1.380	3.00 1.50	6.00	2.00	7.00	6.00	1.00	10.00	10.00	6.00
2.067	5.00 2.50	10.00	3.00	11.00	6.00	1.00	10.00	10.00	10.00

PAGE: B MATERIAL: THNWL HWC: 120

Diameter (in)	Equivalent Fitting Lengths in Feet								
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	A AlmChk	D DPVlv	N NPTee
	F F45Ell								
2.635	8.00 4.00	17.00	6.00	19.00	10.00	1.00	14.00	14.00	17.00
4.260	13.00 6.50	26.00	8.00	29.00	16.00	3.00	26.00	26.00	26.00

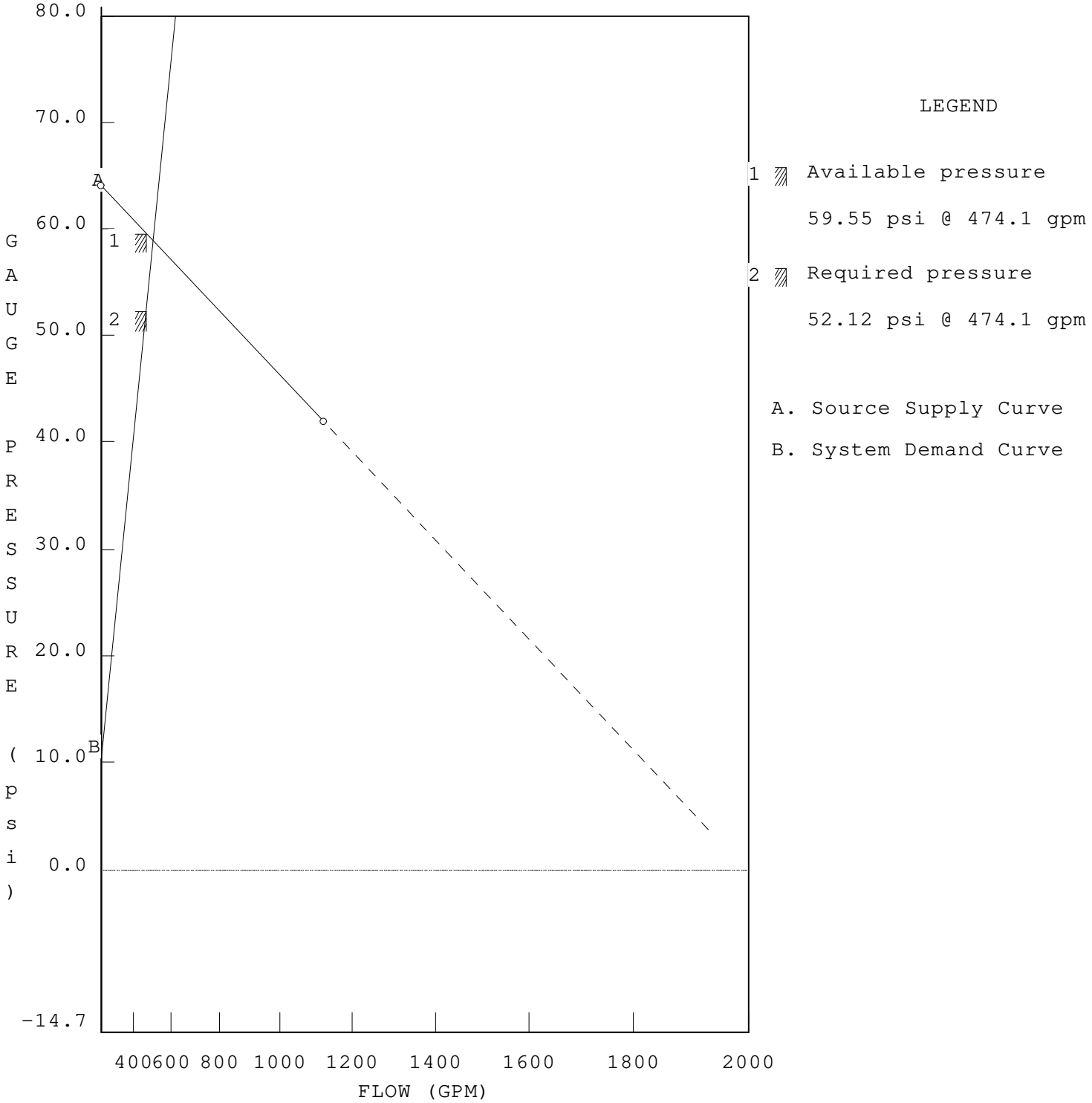
PAGE: D MATERIAL: DIRON HWC: 140

Diameter (in)	Equivalent Fitting Lengths in Feet							
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	N NPTee	F F45Ell
6.280	22.00	47.00	14.00	51.00	16.00	5.00	47.00	11.00
8.390	31.00	59.00	22.00	76.00	20.00	7.00	59.00	15.50
12.460	44.00	98.00	30.00	107.00	34.00	10.00	98.00	22.00

DATE: 8/2/2024\CBAKER\DOCUMENTS\HASSDATA\GULFPORT REHAB\REHAB_OH1_RA2.SDF
JOB TITLE:

WATER SUPPLY ANALYSIS

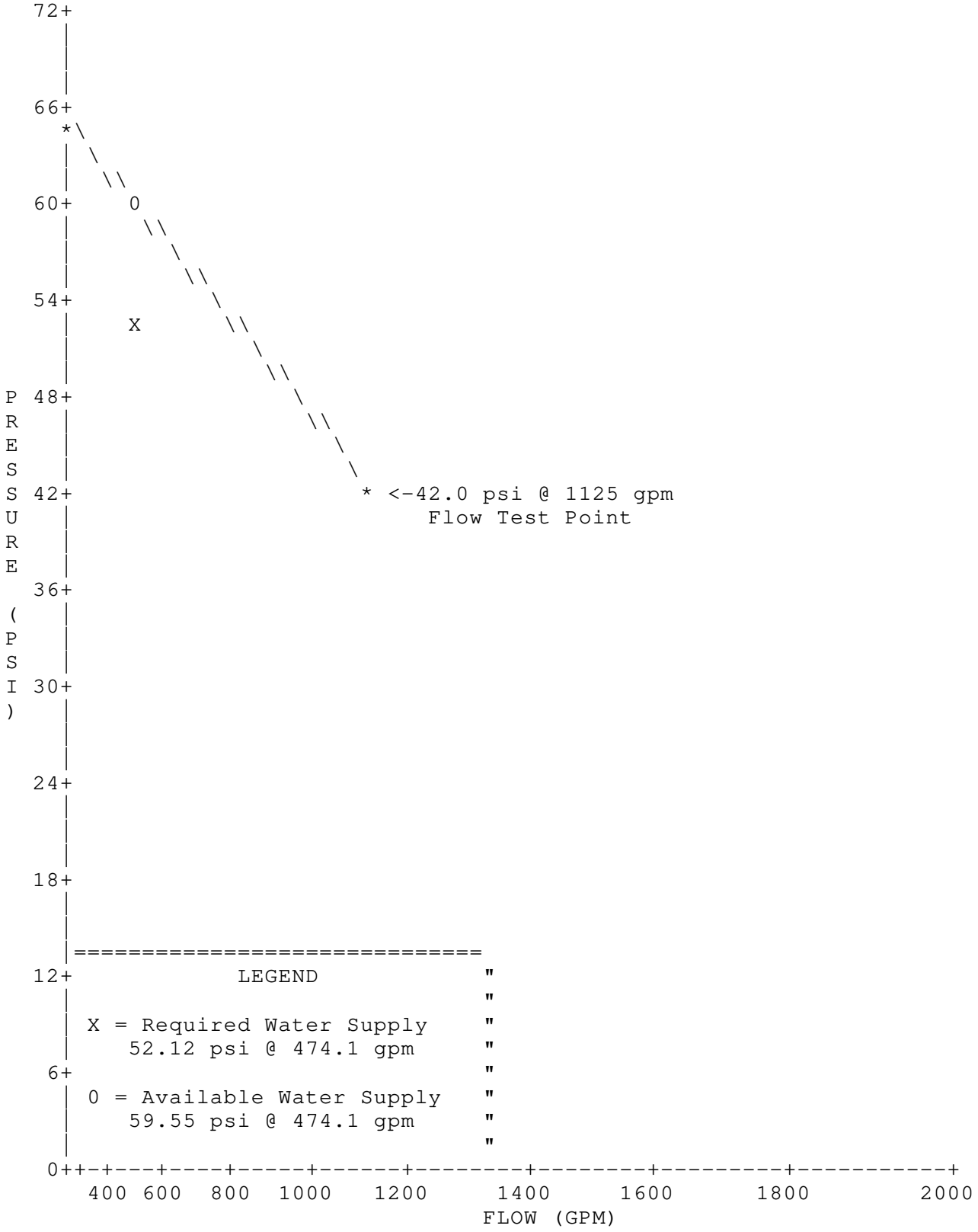
Static: 64.00 psi Resid: 42.00 psi Flow: 1125.0 gpm



Note: (1) Dashed Lines indicate extrapolated values from Test Results

DATE: 8/2/2024\CBAKER\DOCUMENTS\HASSDATA\GULFPORT REHAB\REHAB_OH1_RA2.SDF
JOB TITLE:

WATER SUPPLY CURVE



Utility Report:

Equivalent K-Factor Calculator

Node Name	Sprinkler K-Factor	Pres. (psi)	Dia. (in)	Pipe Len.(ft)	Ftgs.	Total Len.(ft)	H-W coef.	Equivalent K-factor
k5.6-arm	5.60	7.00	1.049	2.50	ET	9.50	120.00	5.34

Equivalent K-Factor Calculator

Node Name	Sprinkler K-Factor	Pres. (psi)	Dia. (in)	Pipe Len.(ft)	Ftgs.	Total Len.(ft)	H-W coef.	Equivalent K-factor
5.6 drop	5.60	7.00	1.049	2.00	T	7.00	120.00	5.40

SECTION 01 10 00 - 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. Owner-furnished products.
6. Access to site.
7. Specification and drawing conventions.

1.3 PROJECT INFORMATION

A. Project Identification: The Gulf Coast Rehabilitation Center

1. Project Location: 1937 Jenks Avenue

B. Owner: John Warren and Randal McElheney

1. Owner's Representatives: Mr. John Warren

C. Architect: Foshee Architects, 21 S. Court Street, Montgomery, Alabama 36104

1. Architect’s Representative: Mr. Barrett Penney, AIA

1.4 WORK COVERED BY CONTRACT DOCUMENTS

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

1. This project consists of construction of the building at 1937 Jenks Avenue, located in Panama City, Florida.

B. Type of Contract:

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

1.5 PHASED CONSTRUCTION

A. The Work shall be conducted in a single phase, which is to be coordinated with the owner.

1.6 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.7 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.

B. Owner-Furnished Products:

1. Furniture, Fixtures and Equipment (FFE) not shown or specified.

1.8 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations. The Owner will direct a portion of existing site areas to be used for the Contractor's laydown area.

B. 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, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or 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.

1.9 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: at discretion of the general contractor.

C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

1.10 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. 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.

END OF SECTION 01 10 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

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 administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

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

2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

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

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Requested substitution provides sustainable design characteristics that specified product provided.
c. Substitution request is fully documented and properly submitted.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals of authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.

i. 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: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

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

a. Requested substitution 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.
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. Requested substitution provides sustainable design characteristics that specified product provided.
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. 3.4 Labor and Materials

C. By making requests for substitutions, the Contractor:

.1 Represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;

.2 Represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified;

.3 Certifies that the cost data presented is complete and includes all related costs under this contract except the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently became apparent; and

.4 Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

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 administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

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 specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with Continuation Sheets.
b. Submittals Schedule.
c. Contractor's Construction Schedule.

2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

    a. Project name and location.
    b. Name of Architect.
    c. Architect's project number.
    d. Contractor's name and address.
    e. Date of submittal.

2. Submit draft of AIA Document G703 Continuation Sheets.
3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value.

        1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.

7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

9. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

10. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Progress payments shall be submitted to Architect by the 5th day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

D. Payment Application Forms: Use AIA Document G702, Modified for Owner Paid Materials, and AIA Document G703 Continuation Sheets as form for Applications for Payment.

E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

    1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
    2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

F. Transmittal: Email signed and notarized copy of the Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Products list.
5. Submittals Schedule (preliminary if not final).
6. List of Contractor's staff assignments.
7. List of Contractor's principal consultants.
8. Copies of building permits.
9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.
13. Performance and payment bonds.
14. Data needed to acquire Owner's insurance.
15. Initial settlement survey and damage report if required.

H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.

8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - 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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project meetings.

B. Related Requirements:

1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, 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. 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.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.

4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

D. 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. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
e. Indicate required installation sequences.
f. 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 Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. 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.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect 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 Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."

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. Architect will return RFIs submitted to Architect 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.
3. Submit in accordance with requirements of Section 01 33 00 "Submittal Procedures."

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 Architect.
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: AIA Document G716 or software-generated form with substantially the same content as indicated above, acceptable to Architect.

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

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 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 Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

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

1. Identification of related Minor Change in the Work, Construction 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 Architect 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 Architect, within three days of the meeting.

B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after the Notice to Proceed date.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
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. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.

v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 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, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for completing documentation.
e. Requirements for preparing operations and maintenance data.
f. Requirements for delivery of material samples, attic stock, and spare parts.
g. Requirements for demonstration and training.
h. Preparation of Contractor's punch list.
i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
j. Submittal procedures.
k. Coordination of separate contracts.
l. Owner's partial occupancy requirements.
m. Installation of Owner's furniture, fixtures, and equipment.
n. Responsibility for removing temporary facilities and controls.

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

E. Progress Meetings: Conduct progress meetings at least monthly but at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of BIM component conflicts.
        4) Status of submittals.
        5) 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.

F. Coordination Meetings: Conduct Project coordination meetings as needed. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.

6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) 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 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

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 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. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
2. Section 01 40 00 "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 Architect.

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.

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 commencement of the Work until most recent Application for Payment.

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

G. Daily Construction Reports: Submit at monthly 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 Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "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 phasing, work stages, area separations, interim milestones, and partial Owner occupancy.
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 resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial 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 Architect.
2. Procurement Activities: Include procurement process activities for 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 resubmittal times indicated in Section 01 33 00 "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 Architect'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 by Owner: Include a separate activity for each portion of the Work performed by Owner.
3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. 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.

6. 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. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.

j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.

7. 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.

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 Section 01 29 00 "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.

2.2 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 commencement of the Work. 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 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 60 days after date established for commencement of the Work.

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 Architect'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.
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. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

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 before each regularly scheduled progress meeting.

2.3 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.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day 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 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 Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

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

B. Related Requirements:

1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

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 Architect 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. 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.

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

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

    a. Architect 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 2010.
c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement or similar Agreement form acceptable to Owner and Architect.
d. The following digital data files will be furnished for each appropriate discipline:

1) Floor plans.
2) Reflected ceiling 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. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

D. Electronic Submittals: Electronic submittals are preferred. 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 as called for in the Example described for Paper Transmittals.

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect**,** containing the same information called for in transmittal for Paper Submittals.

E. Options: Identify options requiring selection by Architect.

F. 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 Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. 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.

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

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. Post electronic submittals as PDF electronic files directly to Architect's FTP site specifically established for Project.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
    b. When posting submittals, simultaneously email copy of transmittal for each submittal to Architect's email address.

2. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
3. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
4. 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. Email digital copy of Product Data unless otherwise indicated. Architect will return two copies.

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 Architect'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, but no larger than 30 by 42 inches. Preferred size for electronic submittals is 11 inches by 17 inches.
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 of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect 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. Architect will retain two Sample sets; remainder will be returned.

        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.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 01 78 23 "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 architects 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 Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit 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 Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 77 00 "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 ARCHITECT'S ACTION

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

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

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

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

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

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 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 Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

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 Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate

aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. 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.

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

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

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

I. 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).

J. 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 Architect 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 Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

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

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.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. 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."
3. Owner-performed tests and inspections indicated in the Contract Documents.

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 Architect 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.

1.8 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 reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, 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.

1.9 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 is similar in material, design, and extent to those indicated for this Project.

F. 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.

G. 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.

H. 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.

I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

J. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.10 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. Costs for retesting and reinspecting 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 Section 01 33 00 "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 preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

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

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

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the 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 as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

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

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's 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 Section 01 73 00 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

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 administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 01 25 00 "Substitution Procedures" for requests for substitutions.

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. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect 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 Section 01 33 00 "Submittal Procedures."
    b. Use product specified if Architect 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 Section 01 33 00 "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, Architect 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 weathertight 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.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 77 00 "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," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "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 not be considered unless otherwise indicated.
    b. Nonrestricted 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 unless otherwise indicated.
    b. Nonrestricted 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.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

    1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a

product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with 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 architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

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 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.

B. Related Requirements:

1. Section 01 10 00 "Summary" for limits on use of Project site.
2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.

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. 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.

B. 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 Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
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.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. 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.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. 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 Architect according to requirements in Section 01 31 00 "Project Management and Coordination."

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 Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. 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.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent

benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

3.5 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 in occupied spaces and 90 inches 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 Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 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 Section 01 10 00 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. 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 rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 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.

3.8 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.
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. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to 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.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components.

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 Section 01 40 00 "Quality Requirements."

3.10 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 01 73 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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 administrative and procedural requirements for the following:

1. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 02 41 19 “Selective Demolition” for disposition of waste resulting from demolition of buildings, structures and site improvements.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, and waste reduction work plan, distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

3.2 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 01 74 19

SECTION 01 77 00 - CLOSEOUT PROCEDURES

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 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. Section 01 73 00 "Execution" for progress cleaning of Project site.
2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion for each phase.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction for each phase.

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 01 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 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit test/adjust/balance records.
5. 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.
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, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 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 Section 01 29 00 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection 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, proceeding from lowest floor to highest floor.
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 Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. PDF electronic file. Architect will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect 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 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.

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. Remove snow and ice to provide safe access to building.

f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

h. Sweep concrete floors broom clean in unoccupied spaces.

i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.

k. Remove labels that are not permanent.

l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

o. 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.

p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

q. Leave Project clean and ready for occupancy.

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 01 77 00

SECTION 01 78 23 - 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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
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. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. 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. Architect and Commissioning Authority 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 Architect.

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. Architect will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority'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 Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect 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, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

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 Section 01 78 39 "Project Record Documents."

G. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

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 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. Section 01 73 00 "Execution" for final property survey.
2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and one of file prints.
3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit three paper-copy sets of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and three sets 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 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 Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record 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 Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect 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 Architect 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 Architect.
    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 paper copy and 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 paper copy and 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 paper copy and 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 Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 21 13 13 - FIRE PROTECTION SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, Sections included under Division 1, General Requirements, and Section 230000 of this Division are included as a part of this Section as though bound herein.

1.02 SECTION INCLUDES

A. Piping system.

B. Wet Pipe Sprinkler System equipment.

C. Fire department connections.

D. Indicator valves.

E. Standpipe/hose valves.

1.03 SUMMARY

A. The Contractor shall provide the labor, materials, equipment, appliances, services and transportation, and perform operations in connection with the construction and installation of the Work.

B. Wet Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

C. Extent of the fire protection system is starting 5 FT outside of the fire pump room, all underground piping and valves and devices from the fire pump to all buildings included in this project, all fire sprinkler piping and devices inside of all buildings and by the requirements of this Section.

D. Work shall be governed by applicable N.F.P.A. codes including N.F.P.A. 24-Private Fire Service Main and Their Appurtenances, FM, UL, the State Fire Marshal, and the local fire department regulations.

1.04 SUBMITTALS

A. The Contractor shall submit detailed shop drawings for approval for all equipment to be constructed and installed. Such shop drawings shall be complete, giving all required information, and shall be properly checked and coordinated with the work of other trades before submission. No work shall be performed until application shop drawings and layout drawings have been approved by the A/E and Fire Marshall.

B. Submittals shall consist of:
1. Certification of compliance with sprinkler designer’s registration seal.
2. Maintenance drawings.
3. Product drawings.
4. Record drawings.

5. Test reports and certificates due upon completion of work and testing.
6. Submit hydraulic calculations and sprinkler and piping layouts for review prior to submission to the local Fire Marshal.
7. Submit calculations and plans to the local Fire Marshal.

1.05 QUALITY ASSURANCE

A. Comply with ANSI, NFPA 13, 2019 EDITION, state and local fire codes.

B. Comply with Factory Mutual "Approval Guide."

C. Sprinkler heads shall be UL and FM listed and shall be located on spacing requirements as noted in NFPA 13, 2019 EDITION according to the hazard designation.

D. Provide fire sprinkler piping products which have been approved and labeled by Underwriters Laboratories.

E. Contractor shall provide to A/E a letter stating compliance with all relevant codes, regulations, standards, and agencies. Also include in the letter the exact location and results of the flow test(s) used to design the system.

F. The system shall be installed by an experienced firm regularly engaged in the installation of fire suppression systems. The contractor shall provide documentation indicating a minimum of five (5) years experience in design, installation, testing and service of these systems.

G. The contractor shall provide a list of at least five (5) references for systems similar in nature and size. This will be required to accompany the quotation for information purposes. Failure to supply this information will result in the bidder being considered non-responsive.

The contractor shall be bonded and maintain project and liability insurance. Minimum liability coverage shall not be less than $2,000,000.00 or 10% of the total installation amount, whichever is greater. Upon receipt of an order, the contractor shall name the Owner as an additionally insured.

1.06 WARRANTY

A. The components of the Fire Protection System(s) furnished under this division of the specifications shall be guaranteed for a period of one (1) year from the date of acceptance thereof, either for beneficial use or final acceptance, whichever is earlier, against defective materials, design and workmanship. Upon receipt of notice from Architect of failure of any part of the equipment during the guarantee period, the affected part or parts, shall be replaced promptly which includes removing the defective part or parts, replacing and installing the new part or parts and at the expense of the contractor.

1.07 SYSTEM OPERATION

A. Requirements
1. Existing fire pump and jockey pump shall include components necessary for maintaining a constant discharge pressure during changes in flow and suction pressure.

PART 2 PRODUCTS

2.01 MATERIALS

A. Acceptable Manufacturers
   1. The Reliable Sprinkler Corp.
   2. Central Sprinkler Co.
   3. Viking Corp.
   4. Victaulic

2.02 PIPING SYSTEMS

A. Aboveground Piping to include schedule 40 black steel and schedule 10 thin wall steel.

B. All SPRINKLER PIPING subject to the outside conditions shall be galvanized pipe. No exception.

C. Piping shall be installed from approved hangers and spacing as required per NFPA 13, 2019 EDITION and Specification Section 230529.

D. Hangers from steel joists must be located at panel points or up to 3 inches on either side of the panel point.

E. Provide inspection and drain valve and label.

F. Valves, meters and gauges are to comply with NFPA 13. Pressure reducing valves shall be provided at floors where indicated on the plans or where required by NFPA 14, 2019 EDITION.

2.03 WET PIPE SPRINKLER SYSTEM EQUIPMENT

A. Provide automatic sprinklers as listed by UL and F.M.
   1. Provide brass upright and side wall sprinklers as required on exposed piping in unfinished spaces.
   2. Provide chrome recessed pendent sprinkler heads in finished areas such as storage rooms and janitors closets.
   3. Provide white recessed pendent heads with matching escutcheon in all finished areas except as noted on the plans.
   4. Center heads in ceiling tile in corridors. All other heads in lay-in ceiling areas shall be in tile to within ½" (inch) of grid.

B. Provide vane type waterflow indicator with electronic retard adjustable up to 90 seconds. Units shall comply with NFPA #72. Provide Potter Electric VSR-F waterflow indicator.

C. Provide a valve position supervisory switch for monitoring control valve. Provide Potter Electric PCVS or OSYSU-A2 supervisory switch.

D. Provide a test station for testing alarm systems. Provide control valve test and drain assembly.

E. Provide grooved check valves and butterfly valves with tamper units in locations as required.

2.04 FIRE DEPARTMENT CONNECTIONS

A. Fire department siamese connection shall be free standing remote type; three-way connection (2-1/2 inch by 2-1/2 inch 6 inch) (2-way); straight body; polished chrome body with escutcheon; body inlets complete with individual drop clapper valve and plugs with secure chains; nominal 4-1/2 inch by 12 inch cast brass wall plate with words "CONNECTION TO WET PIPE SPRINKLERS" in 1 inch raised letters; hose connections shall conform to local Fire Department standards.

2.05 INDICATOR VALVE

A. Indicator valves shall be O.S.& Y. or butterfly. All control valves shall have tamper switches.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fire protection signs on piping in accordance with ANSI/NFPA 13, 2019 EDITION and ANSI/NFPA 14, 2019 EDITION requirements.

B. Comply with requirements of ANSI/NFPA 13, 2019 EDITION for installation of fire sprinkler piping materials. Install fire sprinkler piping products where indicated, in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that fire sprinkler piping complies with requirements and serves intended purposes.

C. Coordinate with other work, including plumbing, HVAC, electrical, etc., as necessary to interface components of fire sprinkler piping properly with other work.

D. Install supports, anchors, seals, valves, meters, and gauges per NFPA 13, 2019 EDITION and other sections of this specification.

E. Prior to connecting sprinkler risers for flushing, flush water feed mains, lead-in connections, and control portions of sprinkler piping. After fire sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system, as required to remove foreign substances, under pressure as specified in ANSI/NFPA 13, 2019 EDITION. Continue flushing until water is clear and check to ensure that debris has not clogged sprinklers.

F. After flushing system, test fire sprinkler piping hydrostatically, for a period of 2 hours, at not less than 200 psi or at 50 psi in excess of maximum static pressure when maximum static pressure is in excess of 150 psi. Check system for leakage of joints. Measure hydrostatic pressure at low point of system.

G. Repair or replace piping system as required to eliminate leakage in accordance with ANSI/NFPA standards. Retest as specified to demonstrate compliance.

H. Furnish per NFPA 13, 2019 EDITION additional sprinkler heads for each type of head provided, complete with metal wall cabinet.

3.02 FIELD QUALITY CONTROL

A. Contractor is responsible for coordinating and witnessing all flow tests with the local water utility.

B. Flow test shall be taken on the main to which the building supply and the fire protection are to connect. The location of the test shall not exceed a distance of 500 feet from the point of connection. If there are no hydrants on the main to which the building is to connect, the Contractor shall contact the A/E for approval on the nearest alternative location.

C. In the situation that the building supply is to connect to a main, which is a lateral branch between two mains of equal or greater size, the Contractor shall execute flow tests on both of the other mains. Flow test locations on the two mains are not to exceed a distance of 500 feet from the point of connection to the lateral branch main. A flow test shall also be taken on the lateral branch main to which the building is to connect. Flow test on the lateral branch main shall be executed as per part (B) above.

D. Flow test(s) shall not be dated earlier than the date of the bid opening. Results obtained by the Contractor are to be forwarded to the A/E within 7 days.

END OF SECTION 21 13 13

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SECTION 21 22 00 - FIRE SUPPRESSION SYSTEMS

SECTION 1 – GENERAL CONDITIONS

1. SCOPE:

This specification outlines the requirements for a “Total Flood” ECARO-25™ clean agent fire suppression system utilizing HFC-125 as the fire extinguishing agent and with a SHP PRO® conventional detection and control system. The work described in this specification includes all engineering, labor, materials, equipment and services necessary, and required, to complete and test the suppression and detection system.

2. APPLICABLE STANDARDS AND PUBLICATIONS:

The design, equipment, installation, testing and maintenance of the clean agent System shall be in compliance and accordance with the applicable requirements set forth in the latest edition of the following codes, standards, and third party approval agencies:

a) NFPA No. 2001 - Clean Agent Fire Extinguishing Systems
b) NFPA No. 70 - National Electrical Code
c) NFPA No. 72 - National Fire Alarm Code
d) FM Approvals
e) Underwriters Laboratory
f) Requirements of the Authority Having Jurisdiction (AHJ)

The standards listed, as well as all other applicable codes and standards shall be used as "minimum" design standards. Also to be considered are the requirements of the "Authority Having Jurisdiction" and good engineering practices.

3. REQUIREMENTS:

The ECARO-25 clean agent system installation shall be made in accordance with the drawings, specifications and applicable standards. Should a conflict occur between the drawings and specifications, the specifications shall prevail.

4. EXCLUSIONS:

The work listed below shall be provided by others, or under other sections of this specification:

a) 120 VAC or 240 VAC power supply to the system control panel.
b) Interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies, relays or shunt trip breakers.
c) Connection to local/remote fire alarm systems, listed central alarm station(s).

5. QUALITY ASSURANCE:

1) MANUFACTURER:
   a) The manufacturer of the clean agent system hardware and detection components shall have a minimum of 10 years experience in the design and manufacture of similar types of suppression systems and who refer to similar installations providing satisfactory service.
   b) The name of the manufacturer, part numbers and serial numbers shall appear on all major components.
   c) All devices, components and equipment shall be the products of the same manufacturer.
   d) All devices, components and equipment shall be new, standard products of the manufacturer’s

latest design and suitable to perform the functions intended.

e) All devices and equipment shall be U.L listed or FM approved.

f) Locks for all cabinets shall be keyed alike.

2) INSTALLER:

a) The installing contractor shall be trained by the supplier to design, install, test and maintain a clean agent system.

b) When possible, the installing contractor shall employ a NICET certified special hazard designer, level 2 or above, who will be responsible for this project.

c) The installing contractor shall be an experienced firm regularly engaged in the installation of automatic clean agent, or similar, fire suppression systems in strict accordance with all applicable standards.

d) The installing contractor must have a minimum of five (5) years experience in the design, installation and testing of clean agent, or similar, fire suppression systems. A list of systems of a similar nature and scope shall be provided on request.

e) The installing contractor shall show evidence that his company carries a minimum $2,000,000.00 liability and completed operations insurance policy. These limits shall supersede limits required in the general conditions of the specifications.

f) The installing contractor shall maintain, or have access to, a clean agent recharging station. The installing contractor shall provide proof of his ability to recharge the largest clean agent system within 24 hours after a discharge. Include the amount of bulk agent storage available.

g) The installing contractor shall be an authorized stocking distributor of the clean agent system equipment so that immediate replacement parts are available from inventory.

h) The installing contractor shall show proof of emergency service available on a twenty-four hour, seven-day-a-week basis.

3) SUBMITTALS:

a) The installing contractor shall submit the following design information and drawings for approval prior to starting work on this project:

1) Field installation layout drawings having a scale of not less than 1/8”=1’-0” (1:100m) detailing the location of all agent storage tanks, pipe runs including pipe sizes and lengths, control panel(s), detectors, manual pull stations, abort stations, audible and visual alarms, etc.

2) Auxiliary details and information such as maintenance panels, door holders, special sealing requirements and equipment shutdowns.

3) Separate layouts, or drawings, shall be provided for each level, (i.e.; room, underfloor, and above ceiling) and for mechanical and electrical work.

4) A separate layout or drawing, shall show isometric details of agent storage containers, mounting details and proposed pipe runs and sizes.

5) Electrical layout drawings shall show the location of all devices and include point-to-point conduit runs and a description of the method(s) used for detector mounting.

6) Provide an internal control panel wiring diagram which shall include power supply requirements and field wiring termination points.

7) Graphic Annunciator wiring schematics and dimensioned display panel illustration shall be provided. (Optional device)

8) Complete hydraulic flow calculations, from Fike’s UL/FM Approved ECARO-25 Flow Calculation Program, shall be provided for all engineered Clean Agent systems. The individual sections of pipe to be used, as shown on the isometrics, must be identified and included in the calculation. Total agent discharge time must be shown and detailed by zone.

9) Provide calculations for the battery stand-by power supply taking into consideration the power

requirements of all alarms, initiating devices and auxiliary components under full load conditions.

10) A complete sequence of operation shall be submitted detailing all alarm devices, shutdown functions, remote signaling, damper operation, time delay and agent discharge for each zone or system.

b) Submit drawings, calculations and system component data sheets for approval to the local Fire Prevention Agency, owners Insurance Underwriter, and all other Authorities Having Jurisdiction before starting installation. Submit approved plans to the Architect/Engineer for record.

SECTION 2 – AGENT REQUIREMENTS

1. SYSTEM DESCRIPTION AND OPERATION:

a) The system shall be a Fike ECARO-25 clean agent system utilizing HFC-125 as the fire extinguishing agent supplied by:

Fike Corporation
704 South 10th Street
Blue Springs, MO 64015

b) The ECARO-25 system shall provide a minimum design concentration of 8.0%, by volume, in all areas and/or protected spaces, at the minimum anticipated temperature within the protected area. Per NFPA 2001, the system design shall not exceed a maximum exposure limit concentration level of 11.5%, by volume, unless provisions for room evacuation, before agent release, are provided. All personnel should be able to leave the protected space prior to the discharge or at least within 5 minutes of the commencement of discharge.

c) The system shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, agent storage containers, ECARO-25 agent, system actuation equipment, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/ advisory signs, functional checkout and testing, training and all other operations necessary for a functional U.L. Listed and/or F.M. Approved ECARO-25 clean agent system.

d) Provide two (2) inspections during the first year of service. Inspections shall be made at 6 month intervals commencing when the system is first placed into normal service.

e) The general contractor shall be responsible for sealing and securing the protected spaces against agent loss and/or leakage during the 10 minute "hold" period.

f) The system(s) shall be actuated by a combination of ionization and/or photoelectric detectors installed in accordance with the guidelines stated in NFPA 72.

g) Detectors shall be wired in Sequential Detection method of operation, standard Cross-Zoned detection, or single detector release. No other detection / wiring arrangements will be acceptable.

h) Automatic operation of each protected area shall be as follows:

1) Actuation of one (1) detector, within the system, shall:

a) Illuminate the "ALARM" lamp on the control panel face.

b) Energize an alarm bell and/or an optional visual indicator.

c) Transfer sets of 5 Amp rated auxiliary contacts which can perform auxiliary system functions such as:

1) Operate door holder/closures on access doors.

2) Transmit a signal to a fire alarm system.

3) Shutdown HVAC equipment.

d) Light an individual lamp on an optional graphic annunciator.

2) Actuation of a 2nd detector, within the system, shall:

a) Illuminate the "PRE-DISCHARGE" lamp on the control panel face.

b) Energize a pre-discharge horn or horn/strobe device.
c) Shut down the HVAC system and/or close dampers.
d) Start time-delay sequence (not to exceed 60 seconds).
e) System abort sequence is enabled at this time.
f) Light an individual lamp on an optional graphic annunciator.

3) After completion of the time-delay sequence, the ECARO-25 clean agent system shall activate and the following shall occur:
a) Illuminate a "RELEASE" lamp on the control panel face.
b) Shutdown of all power to high-voltage equipment
c) Energize a visual indicator(s) outside the hazard in which the discharge occurred.
d) Energize a "System Release" audible device. (Optional)

4) The system shall be capable of being actuated by manual discharge devices located at each hazard exit. Operation of a manual device shall duplicate the sequence description above except that the time delay and abort functions SHALL be bypassed. The manual discharge station shall be of the electrical actuation type and shall be supervised at the main control panel.

5) The system shall be capable of providing a “PRE-ALARM” feature that can give advanced warning of a possible alarm condition.

2. MATERIALS AND EQUIPMENT:

a) GENERAL REQUIREMENTS:

The ECARO-25 clean agent system materials and equipment shall be standard products of the supplier's latest design and suitable to perform the functions intended. When one or more pieces of equipment must perform the same function(s), they shall be duplicates produced by one

Manufacturer.

1) All devices and equipment shall be U.L. Listed and/or F.M. Approved.

b) ECARO-25 AGENT STORAGE AND DISTRIBUTION:

Each system shall have its own supply of clean agent.

1) The system design can be modular, central storage, or a combination of both design criteria utilizing a fast acting rupture disc valve. The valve shall contain a scored, non-fragmenting, rupture disc to provide immediate total discharge of the ECARO-25 agent.

2) Systems shall be designed in accordance with the manufacturer's guidelines.

3) Each supply shall be located within the hazard area, or as near as possible, to reduce the amount of pipe and fittings required to install the system.

4) The clean agent shall be stored in FIKE P/N 70-XXX Series Agent Storage Containers. Containers shall be super-pressurized, with dry Nitrogen, to an operating pressure of 360 psi @ 70° F (25 bar @ 21° C). Containers shall be of high-strength alloy steel construction and conform to NFPA 2001.

5) Containers shall be actuated by parallel wired Gas Cartridge Actuators through a Fike P/N 10-1832 Agent Release Module (ARM), located at each agent storage container. A maximum of six (6) agent release modules (ARM), Fike P/N 10-1832, are supported by a single SHP PRO Panel.

6) Each container shall have a pressure gauge and low pressure switch to provide visual and electrical supervision of the container pressure. The low pressure switch shall be wired to the control panel to provide an audible and visual "Trouble" alarm in the event the container pressure drops below 288 psi (19 bar). The pressure gauge shall be color coded to provide an easy, visual indication of container pressure.

7) Each container shall have a pressure relief provision that automatically operated when the internal temperature exceed 150° F (66° C).

8) Engineered discharge nozzles shall be provided, within the manufacturer's guidelines, to distribute the ECARO-25 agent throughout the protected spaces. The nozzles shall be FIKE P/N

85-XXX designed to provide proper agent quantity and distribution.

a) Nozzles shall be available in NPT sizes ¼" – 2.0" (8mm- 50mm). Each size shall be available in 180° and 360° distribution patterns.

9) Distribution piping, and fittings, shall be installed in accordance with the manufacturer's requirements, NFPA 2001 and approved piping standards and guidelines. All distribution piping shall be installed by qualified individuals using good, accepted practices and quality procedures. All piping shall be adequately supported and anchored at all directional changes and nozzle locations.

a) All piping shall be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oils before assembly.

b) All pipe threads shall be sealed with Teflon tape pipe sealant applied to the male thread ONLY.

SECTION 3 – ELECTRICAL REQUIREMENTS

1) CONTROL PANEL:

a) The control panel shall be a SHP PRO Conventional Control Panel, P/N 10-063-M-C-P, manufactured by Fike Corporation, Blue Springs, MO.

1. The SHP PRO Control System, and its components, shall be UL listed and FM approved for releasing service and be suitable for Deluge/Pre-action sprinkler service.
2. The SHP PRO Control System shall perform all functions necessary to operate the system detection, actuation and auxiliary functions, as outlined.
3. The SHP PRO Control System shall be capable of providing 7AH or 40AH battery standby power supplies.
4. The SHP PRO Control System shall be microprocessor based with hardware and software integration designed to guarantee reliability.
5. The SHP PRO Control System shall support Cross Zoned, Sequential, Single Detector Release and Manual Release detection/actuation methods.
6. The SHP PRO Control System shall provide the following capabilities and functions:
   a) Three (3) Class B (Style Y) notification appliance circuits rated for 2.0 amps @ 24 VDC.
   b) Up to two (2) Style B initiating device circuits capable of sequential alarm, cross-zone, or single detector release operation with an overall system capacity of 50 detectors maximum.
   c) Three (3) Style B initiating device circuits capable of monitoring closed contact devices.
   d) Optional Class A module that converts all five initiating device circuits to Style D wiring and operation.
   e) Optional Class A module that converts all five output circuits to Style Z (3 NAC, 2 Releasing)
   f) Eight (10) Status LEDs plus alpha-numeric display for troubleshooting: AC normal; alarm; pre-discharge; release; supervisory; trouble; panel silenced; abort; release disabled; and ground fault.
   g) Programmable pre-discharge and discharge timers
   h) Resettable and continuous auxiliary output power
   i) Five (5) optional Abort types
   j) Intelligent Transistor protection to prevent noise spikes and microprocessor failure from inadvertently activating release outputs
   k) A dedicated Disarm switch for release outputs
   l) Dedicated alarm and trouble contacts programmable for alarm, trouble, pre-discharge, discharge, abort, supervisory or water flow functions, depending on panel configuration.
   m) Two (3) Form "C" relays, rated at 2 amps, are provided on the SHP PRO™ panel board.

Installation of up to two (2) optional CRM4 Relay Module (P/N 10-2204) will provide up to eight (8) additional 2 amp relays.

n) Multiple input power source - 120 VAC or 240 VAC

o 4.0 amp @ 24 VDC power supply to operate high current draw horns and strobes.

p) Available in either Red or Gray finish

2) DETECTOR BASES:

The detector bases shall be selected according to their operational characteristics and size of base.

a. 430 ohm bases are used to provide Sequential or Cross Zone detection on the SHP PRO initiating circuits. The bases shall be Fike P/N 67-1034 (6”/15mm) base, or P/N 67-1036 (4”/10mm) base. *

b. 220 ohm bases are used to provide Cross Zone or Single Detector Release detection on the SHP PRO initiating circuits. The bases shall be Fike P/N 67-1035 (6”/15mm) base, or P/N 67-1037 (4”/10mm) base. *

c. When using the SHP PRO in conjunction with a Graphic Annunciator panel, the following old style bases must be used.

1. Fike P/N 67-1034 (6”/15 cm) 430 ohm base.
2. Fike P/N 67-1036 (4”/10 cm) 430 ohm base.
3. Fike P/N 67-1035 (6”/15 cm) 220 ohm base.
4. Fike P/N 67-1037 (4”/10 cm) 220 ohm base.

* Additional bases are available from Fike Corporation.

3) MANUAL RELEASE (Electric):

The electric manual release switch shall be a dual action device which provides a means of manually discharging the ECARO-25 clean agent system when used in conjunction with the Fike SHP PRO Control System.

a) The Manual Release switch shall be a Fike P/N 10-1638 or a Manual Pull station, P/N 02-3710.

b) The Manual Release switch or Manual Pull station shall be a dual action device requiring two distinct operations to initiate a system actuation.

c) Manual actuation shall bypass the time delay and abort functions, shall cause the system to discharge and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.

d) A Manual Release or Manual Pull switch shall be located at each exit from the protected hazard and shall have an advisory sign, Fike P/N 02-10312, provided at each location.

e) The Manual Release or Manual Pull station shall be connected to a FRCM which is programmed for the intended function.

4) MANUAL RELEASE (Mechanical):

Mechanical Manual Release shall be made available in the event all battery back-up and commercial power is lost. Fike P/N 10-2225, Manual Actuator, shall be installed and located as close to the ECARO-25 storage containers as possible. Consideration should be given for convenience of operation and egress from the hazard area(s).

5) ABORT STATION (Optional):

The optional Abort Station shall be the "Dead Man" type and shall be located next to each manual switch.

a) "Locking" or "Keyed" abort stations shall not be permitted.

b) The Abort Station shall be a Fike P/N 10-1639.

c) The Abort Station shall be supervised and shall indicate a trouble condition at the SHP PRO Control Panel, if depressed, and no alarm condition exists.
d) The (optional) Abort Station shall be located adjacent to each manual station and can be furnished in combination with a Manual Release Switch or in combination with a Manual Release Switch and (optional) Digital Countdown Timer (Fike P/N 20-046).
e) The Abort Station shall be connected to a FRCM which is programmed for the intended function.

6) AUDIBLE and VISUAL ALARMS:

Alarm audible and visual signal devices shall operate from the SHP PRO Control Panel.

a) The Alarm Bell, Alarm Horn and Horn/Strobe devices shall be Fike P/N's 20-XXX, or equal in quality, performance and features. An HFC-125 label shall be attached to the strobe lens when required.
b) The visual alarm unit shall be a Fike P/N 20-XXX Vertical Strobe device, or equal in quality, performance and features. An HFC-125 label shall be attached to the strobe lens when required.
c) A Strobe device shall be placed outside, and above, each exit door from the protected space. Provide an advisory sign, Fike P/N 02-10313, at each light location.

7) CAUTION and ADVISORY SIGNS:

Provide signs, as required, to comply with NFPA 2001 and the recommendations of the ECARO-25 equipment supplier:

a) Entrance sign: One (1) required at each entrance into a protected space. (Fike P/N 02-10314)
b) Manual Discharge sign: One (1) required at each manual discharge station. (Fike P/N 02-10312)
c) Flashing Light sign: One (1) required at each flashing light over each exit from a protected space. (Fike P/N 02-10319 or 02-10313)

8) AUXILIARY PANELS: (Optional)

a) A Graphic Annunciator panel will be mounted adjacent to the SHP PRO control panel. The graphic annunciator shall show a scale layout of the protected area(s) and have indicator lamps to locate each system detector and/or other system components. The panel shall have a lamp test switch located on the panel face. Other panel options shall be available. Scale shall not be less than 1/8" = 1'-0" (1:100 m).

9) SYSTEM and CONTROL WIRING:

All system wiring shall be furnished and installed by the contractor.

a) All wiring shall be installed in electrical metallic tubing (EMT), or conduit, and must be installed and kept separate from all other building wiring.
b) All system components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, installed parallel and perpendicular to walls and partitions.
c) The sizes of the conductors shall be those specified by the manufacturer. Color coded wire shall be used. All wires shall be tagged at all junction points and shall be free from shorts, earth connections (unless so noted on the system drawings), and crosses between conductors. Final terminations between the SHP PRO control panel and the system field wiring shall be made under the direct supervision of a factory trained representative.
d) All wiring shall be installed by qualified individuals, in a neat and workmanlike manner, to conform to the National Electrical Code, Article 725, and Article 760, except as otherwise permitted for limited energy circuits, as described in NFPA 72 -1993 edition. Wiring installation shall meet all

local, state, province and/or country codes.

e) The complete system electrical installation, and all auxiliary components, shall be connected to earth ground in accordance with the National Electrical Code.

10) SYSTEM INSPECTION and CHECKOUT:

After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer's recommended procedures and NFPA standards.

a) All containers and distribution piping shall be checked for proper mounting and installation.

b) All electrical wiring shall be tested for proper connection, continuity and resistance to earth.

c) The complete system shall be functionally tested, in the presence of the owner or his representative, and all functions, including system and equipment interlocks, must be operational at least five (5) days prior to the final acceptance tests.

1) Each detector shall be tested in accordance with the manufacturers recommended procedures, and test values recorded.

2) All system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, local and remote alarms, etc. shall function as required and designed.

3) Each SHP PRO control panel circuit shall be tested for trouble by inducing a trouble condition into the system. shall be tested for trouble by inducing a trouble condition into the system.

11) TRAINING REQUIREMENTS:

Prior to final acceptance, the installing contractor shall provide operational training to each shift of the owners personnel. Each training session shall include system SHP PRO Control Panel operation, manual and (optional) abort functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

12) OPERATION and MAINTENANCE:

Prior to final acceptance, the installing contractor shall provide complete operation and maintenance instruction manuals, four (4) copies for each system, to the owner. All aspects of system operation and maintenance shall be detailed, including piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s) illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.

13) AS-BUILT DRAWINGS:

Upon completion of each system, the installing contractor shall provide four (4) copies of system "As-Built" drawings to the owner. The drawings shall show actual installation details including all equipment locations (i.e.: control panel(s), agent container(s), detectors, alarms, manuals and aborts, etc.) as well as piping and conduit routing details. Show all room or facilities modifications, including door and/or damper installations completed. One (1) copy of reproducible engineering drawings shall be provided reflecting all actual installation details.

14) ACCEPTANCE TESTS:

a) At the time "As-Built" drawings and maintenance/operations manuals are submitted, the installing contractor shall submit a "Test Plan" describing procedures to be used to test the control

system(s). The Test Plan shall include a step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed. The tests shall demonstrate that the operational and installation requirements of this specification have been met. All tests shall be conducted in the presence of the owner and shall not be conducted until the Test Plan has been approved.

b) The tests shall demonstrate that the entire control system functions as designed and intended. All circuits shall be tested: automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices and manual override of abort functions. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified.

c) A room pressurization test shall be conducted, in each protected space, to determine the presence of openings, which would affect the agent system concentration levels. The test(s) shall be conducted using the Retro-Tec Corp. Door Fan system, or equivalent, with integrated computer program. All testing shall be in accordance with NFPA 2001, current edition.

d) If room pressurization testing indicates that openings exist which would result in leakage and/or loss of the extinguishing agent, the installing contractor shall be responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his sub-contractor or agent. The general contractor shall be responsible for adequately sealing all protected space(s) against agent loss or leakage. The installing contractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed.

   THE SUPPRESSION SYSTEM INSTALLING CONTRACTOR SHALL BE RESPONSIBLE FOR THE SUCCESS OF THE ROOM PRESSURIZATION TESTS.

   If the first room pressurization test is not successful, in accordance with these specifications, the installing contractor shall direct the general contractor to determine, and correct, the cause of the test failure. The installing contractor shall conduct additional room pressurization tests, at no additional cost to the owner, until a successful test is obtained. Copies of successful test results shall be submitted to the owner for record.

e) Upon acceptance by the owner, the completed system(s) shall be placed into service.

15) SYSTEM INSPECTIONS:

a) The installing contractor shall provide two (2) inspections of each system, installed under this contract, during the one-year warranty period. The first inspection shall be at the six month interval, and the second inspection at the 12 month interval, after system acceptance. Inspections shall be conducted in accordance with the manufacturer's guidelines, and the recommendations of NFPA 2013.

b) Documents certifying satisfactory system(s) operation shall be submitted to the owner upon completion of each inspection.

16) WARRANTY:

a) All FIKE system components furnished, and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.

END OF SECTION 21 22 00

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SECTION 22 05 00 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Mechanical demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. 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 thickness or specific material is 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.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
2. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
3. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC PVC CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. 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 Coordination Drawings.

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 to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed exposed-rivet concealed or exposed-rivet hinge and set screw or spring clips.
g. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
h. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. 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 (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
    b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
    c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

        1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 9.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. 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 the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use minimum 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 22 05 00

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SECTION 22 05 19 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following meters and gages for mechanical systems:

1. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections include the following:

1. Division 2 Section "Water Distribution" for domestic and fire-protection water service meters outside the building.
2. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer, gage and flowmeter, signed by product manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or brass, 9 inches long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. Ernst Gage Co.
2. Eugene Ernst Products Co.
3. Marsh Bellofram.
4. Miljoco Corp.
5. Trerice, H. O. Co.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
7. Winters Instruments.

B. Case: Plastic, 9 inches long.

C. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Metal, for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 THERMOWELLS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Palmer - Wahl Instruments Inc.
4. Tel-Tru Manufacturing Company.
5. Trerice, H. O. Co.
6. Weiss Instruments, Inc.
7. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.5 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Palmer - Wahl Instruments Inc.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, drawn steel or cast aluminum 6-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Metal
9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.

1. Case: Dry type, drawn steel or cast aluminum, 6-inch diameter with holes for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Metal.
9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure
11. Range for Fluids under Pressure: Two times operating pressure.

D. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.6 TEST PLUGS

A. Manufacturers:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
4. Carrying case shall have formed instrument padding.

2.7 FLOW INDICATORS

A. Manufacturers:

1. Brooks Instrument Div.; Emerson Electric Co.
2. Dwyer Instruments, Inc.
3. McCrometer, Inc.
4. OPW Engineered Systems; Dover Corp.

B. Description: Instrument for installation in piping systems for visual verification of flow.

C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.

D. Pressure Rating: 125 psig.

E. Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install bimetallic-actuated dial thermometers in the following locations:

1. Inlet and outlet of each zone.
2. Inlet and outlet of each water heater.

B. Install liquid-filled-case-type, vapor-actuated dial thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install test plugs in tees in piping.

3.4 CONNECTIONS

A. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 22 05 19

SECTION 22 05 23 - GENERAL-DUTY VALVES 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following general-duty valves:

1. Copper-alloy ball valves.
2. Ferrous-alloy butterfly valves.
3. Bronze check valves.
4. Ferrous-alloy wafer check valves.
5. Spring-loaded, lift-disc check valves.
6. Resilient-seated, cast-iron, eccentric plug valves.

B. Related Sections include the following:

1. Division 2 piping Sections for general-duty and specialty valves for site construction piping.
2. Division 22 Section "Plumbing Identification" for valve tags and charts.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

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 ball and plug valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. 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 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

G. Valve Grooved Ends: AWWA C606.

1. Solder Joint: With sockets according to ASME B16.18.

a. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check, gate, and globe valves; below 421 deg F (216 deg C) for ball valves.

2. Threaded: With threads according to ASME B1.20.1.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER-ALLOY BALL VALVES

A. Manufacturers:

1. One-Piece, Copper-Alloy Ball Valves:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Stockham Div.
c. Grinnell Corporation.
d. Legend Valve & Fitting, Inc.
e. NIBCO INC.
f. Watts Industries, Inc.; Water Products Div.

2. Two-Piece, Copper-Alloy Ball Valves:

a. Crane Co.; Crane Valve Group; Stockham Div.
b. Grinnell Corporation.
c. Hammond Valve.
d. Honeywell Braukmann.
e. Legend Valve & Fitting, Inc.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corp.
i. Watts Industries, Inc.; Water Products Div.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. One-Piece, Copper-Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 400-psig minimum CWP rating.

D. Two-Piece, Copper-Alloy Ball Valves: Bronze body with full -port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.4 FERROUS-ALLOY BUTTERFLY VALVES

A. Manufacturers:

1. Flangeless, Ferrous-Alloy Butterfly Valves:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Stockham Div.
c. Grinnell Corporation.
d. Hammond Valve.
e. Legend Valve & Fitting, Inc.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corp.
i. Watts Industries, Inc.; Water Products Div.

2. Flanged, Ferrous-Alloy Butterfly Valves:

a. Grinnell Corporation.
b. Mueller Steam Specialty.

B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.

C. Flangeless, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one -piece stem.

D. Flanged, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one-piece stem.

2.5 BRONZE CHECK VALVES

A. Manufacturers:

1. Type 1, Bronze, Horizontal Lift Check Valves with Metal Disc:

a. Crane Co.; Crane Valve Group; Stockham Div.
b. Red-White Valve Corp.
c. Walworth Co.

2. Type 1, Bronze, Vertical Lift Check Valves with Metal Disc:

a. Crane Co.; Crane Valve Group; Jenkins Valves.
b. Red-White Valve Corp.

3. Type 3, Bronze, Swing Check Valves with Metal Disc:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Stockham Div.
c. Grinnell Corporation.
d. Hammond Valve.
e. Legend Valve & Fitting, Inc.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corp.
i. Watts Industries, Inc.; Water Products Div.

B. Bronze Check Valves, General: MSS SP-80.

C. Type 1, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with bronze disc and seat.

D. Type 1, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with bronze disc and seat.

E. Type 3, Class 150, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.

2.6 FERROUS-ALLOY WAFER CHECK VALVES

A. Manufacturers:

1. Dual-Plate, Ferrous-Alloy, Wafer Check Valves:

   a. Crane Co.; Crane Valve Group; Stockham Div.
   b. Grinnell Corporation.
   c. Mueller Steam Specialty.
   d. NIBCO INC.
   e. Red-White Valve Corp.
   f. Techno Corp.
   g. Watts Industries, Inc.; Water Products Div.

2. Dual-Plate, Ferrous-Alloy, Wafer-Lug Check Valves:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Gulf Valve Co.
   c. Valve and Primer Corp.

B. Ferrous-Alloy Wafer Check Valves, General: API 594, spring loaded.

C. Dual-Plate, Class 125 or 150, Ferrous-Alloy, Wafer Check Valves: Flangeless body.

2.7 SPRING-LOADED, LIFT-DISC CHECK VALVES

A. Manufacturers:

1. Type I, Wafer Lift-Disc Check Valves:

   a. Mueller Steam Specialty.

2. Type II, Compact-Wafer, Lift-Disc Check Valves:

   a. GA Industries, Inc.
   b. Grinnell Corporation.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. Mueller Steam Specialty.
   f. NIBCO INC.

3. Type IV, Threaded Lift-Disc Check Valves:

   a. Grinnell Corporation.
   b. Legend Valve & Fitting, Inc.
   c. Milwaukee Valve Company.

d. Mueller Steam Specialty.
e. NIBCO INC.
f. Watts Industries, Inc.; Water Products Div.

B. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.

C. Type I, Class 125, Wafer Lift-Disc Check Valves: Wafer style with cast-iron shell with diameter matching companion flanges.

D. Type II, Class 125, Compact-Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.

E. Type IV, Class 125, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.

2.8 RESILIENT-SEATED, CAST-IRON, ECCENTRIC PLUG VALVES

A. Manufacturers:

1. General Signal; DeZurik Unit.
2. Milliken Valve Company.
3. Olson Technologies; Homestead Div.
4. Pratt, Henry Company.

B. Resilient-Seated, Cast-Iron, Eccentric Plug Valves, NPS 2-1/2 and Smaller: Design similar to MSS SP-108, and rated for 175-psig minimum CWP.

C. Resilient-Seated, Cast-Iron, Eccentric Plug Valves, NPS 3 and Larger: MSS SP-108, and rated for 175-psig minimum CWP.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly or plug valves.
2. Throttling Service: Ball or butterfly valves.
3. Pump Discharge: Spring-loaded, lift-disc check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Chilled-Water Piping: Use the following types of valves:

1. Angle Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 150 bronze.
2. Angle Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 250, cast iron.
3. Ball Valves, NPS 2 (DN 50) and Smaller: Three-piece, 400-psig (2760-kPa) CWP rating, copper alloy.
4. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 300, ferrous alloy.
5. Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Flangeless 300-psig (2070-kPa) CWP rating, ferrous alloy, with EPDM liner.
6. High-Pressure Butterfly Valves, NPS 3 (DN 80) and Larger: Single-flange, Class 300.
7. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: 300-psig (2070-kPa) CWP rating.
8. Lift Check Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 150 horizontal, bronze.
9. Swing Check Valves, NPS 2 (DN 50) and Smaller: Type 4, Class 200, bronze.
10. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 250, gray iron.
11. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: 300-psig (2070-kPa) CWP rating.
12. Wafer Check Valves, NPS 2-1/2 (DN 65) and Larger: Single-plate, double-flanged, Class 250 or 300 ferrous alloy.
13. Spring-Loaded, Lift-Disc Check Valves, NPS 2 (DN 50) and Smaller: Type IV, Class 125 minimum.
14. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 (DN 65) and Larger: Type I I or II II III, Class 125 250, cast iron.
15. Gate Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 200 bronze.
16. Gate Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 250, bronze-mounted cast iron.
17. Globe Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 150 bronze.
18. Globe Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 250, bronze-mounted cast iron.
19. Plug Valves, NPS 2 (DN 50) and Larger: Class 250 or 300, lubricated type, cast iron.
20. Resilient-Seated, Eccentric Plug Valves, NPS 3 (DN 80) and Larger: 175-psig (1207-kPa) CWP rating, cast iron.

D. Domestic Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: One -piece, 400-psig CWP rating, copper alloy.
2. Butterfly Valves, NPS 2-1/2 and Larger: Flangeless or Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
3. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 125, horizontal or vertical bronze.
4. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125 bronze.
5. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125 gray iron.

6. Wafer Check Valves, NPS 2-1/2 and Larger: Single, Dual-plate, wafer, wafer-lug double-flanged, Class 125 or 150, ferrous alloy.
7. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 125 minimum.
8. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type I or II Class 125 cast iron.
9. Resilient-Seated, Eccentric Plug Valves, NPS 3 and Larger: 175-psig CWP rating, cast iron.

E. Select valves, except wafer and flangeless types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Solder-joint or threaded ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded ends.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded ends.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Grooved-End, Copper Tubing and Steel Piping: Valve ends may be grooved.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Basic Materials and Methods" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 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.

END OF SECTION 22 05 23

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SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for mechanical system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Equipment supports.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
3. Division 22 Section "Pipe Expansion Fittings and Loops" for pipe guides and anchors.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Globe Pipe Hanger Products, Inc.
3. Grinnell Corp.
4. National Pipe Hanger Corporation.
5. PHD Manufacturing, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Power-Strut Div.; Tyco International, Ltd.
3. Thomas & Betts Corporation.
4. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
1. PHS Industries, Inc.
2. Pipe Shields, Inc.
3. Value Engineered Products, Inc.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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.

1. Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Hilti, Inc.
c. ITW Ramset/Red Head.
d. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified 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. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 6, if little or no insulation is required.
3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
4. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
6. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
7. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
8. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 6.
9. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
10. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 8, from single rod if horizontal movement caused by expansion and contraction might occur.
11. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 8, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
12. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 8, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
13. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 8, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

F. 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 8.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 8, if longer ends are required for riser clamps.

G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

H. 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.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

I. 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.

J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.

b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel 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 building structure.

B. 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 above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

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. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

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. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and

larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so 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 so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

K. Insulated Piping: Comply with the following:

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 according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 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 smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

3.5 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.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 05 29

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Pipe markers.
5. Stencils.
6. Valve tags.
7. Valve schedules.
8. Warning tags.

1.3 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. Valve numbering scheme.

D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 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 location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:

a. Name and plan number.
b. Equipment service.
c. Design capacity.
d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: 1/16 inch, unless otherwise indicated.
4. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.3 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Aluminum Stencil Paint: Exterior, gloss, acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
2. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect <Insert other>. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick aluminum.
2. Material: 0.0375-inch- thick stainless steel.
3. Material: 3/32-inch- thick laminated plastic with 2 black surfaces and white inner layer.
4. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook VALVE SCHEDULES

B. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches Fasteners: Brass grommet and wire.
2. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
3. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
2. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
3. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 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.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Fire department hose valves and hose stations.
    c. Meters, gages, thermometers, and similar units.
    d. Pumps, compressors, condensers, and similar motor-driven units.
    e. Heat exchangers, coils, evaporators, and similar equipment.
    f. Packaged HVAC central-station and zone-type units.

C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with equipment markers in the following color codes:

    a. Green: For cooling equipment and components.
    b. Yellow: For heating equipment and components.
    c. Orange: For combination cooling and heating equipment and components.

2. Letter Size: Minimum 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.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. Include signs for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Pumps, compressors, condensers, and similar motor-driven units.
    c. Heat exchangers, coils, evaporators, and similar equipment.
    d. Packaged HVAC central-station and zone-type units.

E. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

F. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.

2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers 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 markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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 markers.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches, 2 inches, round square.
b. Hot Water: 1-1/2 inches, 2 inches, round square.
c. Fire Protection: 1-1/2 inches, 2 inches, round square.
d. Gas: 1-1/2 inches, 2 inches, round square.
e. Steam: 1-1/2 inches, 2 inches, round square.

2. Valve-Tag Color:

a. Cold Water: Green.
b. Fire Protection: Red
c. Gas: Yellow

3. Letter Color:

a. Cold Water: White.
b. Fire Protection: White.

c. Gas: White.

3.5 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END SECTION 22 05 33

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SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

   a. Cellular glass.
   b. Flexible elastomeric.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

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, flanges, valves, and specialties for each type of insulation.
3. Detail removable insulation at piping specialties, equipment connections, and access panels.
4. Detail application of field-applied jackets.
5. Detail field application for each equipment type.

C. Remaining paragraphs are defined in Division 01 Section "Submittal Procedures" as "Informational Submittals."

D. Qualification Data: For qualified Installer.

E. 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.

F. Field quality-control reports.

1.4 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting 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.

1.5 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 size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

1.7 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 Part 3 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, provide one of the following:

a. Cell-U-Foam Corporation; Ultra-CUF.
b. Pittsburgh Corning Corporation; Foamglas Super K.

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 or ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.2 ADHESIVES

A. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-96.
b. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. 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 Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); 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; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.

f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, 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, 59 percent by volume and 71 percent by weight.
5. Color: White.

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

C. Description: Shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.4 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 Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.

2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-70.
b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.
7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. 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. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

    a. Products: Subject to compliance with requirements, provide the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

5. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

    a. Products: Subject to compliance with requirements, provide the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

    a. Products: Subject to compliance with requirements, provide the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, provide the following:

a. Vimasco Corporation; Elastafab 894.

B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Products, Division of ITW; Chil-Glas No. 5.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White Color-code jackets based on system.
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.

5. Factory-fabricated tank heads and tank side panels.

2.8 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. 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.

2.9 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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.
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.

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 and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer 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.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping".

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to 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 from insulation end joints, and 16 inches o.c. in both directions.
d. Do not overcompress 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 from each end. Install wire or cable between two circumferential girdles 12 inches 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 o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
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. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.6 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, vessels, and equipment. 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.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

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 but 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.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 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 PVC jackets are indicated, install with 1-inch 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.

3.10 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

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.

3.11 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Domestic water storage tank insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 1 inch thick.

3.12 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.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

B. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

C. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch thick.

E. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

G. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.

END OF SECTION 22 07 00

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SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes domestic water piping inside the building.

B. Water meters will be furnished and installed by utility company.

C. Related Sections include the following:

1. Division 2 Section "Water Distribution" for water-service piping outside the building from source to the point where water-service piping enters the building.
2. Division 22 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
3. Division 22 Section "Plumbing Specialties" for water distribution piping specialties.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 80 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

A. Piping 4” and smaller - Hard Copper Tube: ASTM B 88, Types L (ASTM B 88M, Types B), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.4 STAINLESS STEEL PIPING

A. Type 304 stainless steel socket weld or threaded end fittings. ANSI 1 B16.3, B16.5.

2.5 VALVES

A. Bronze and cast-iron, general-duty valves are specified in Division 22 Section "Valves."

A. Balancing and drain valves are specified in Division 22 Section "Plumbing Specialties."

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 PIPE AND FITTING APPLICATIONS

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 may be used on aboveground piping, unless otherwise indicated.

C. Grooved joints may be used on aboveground grooved-end piping.

D. Domestic Water Piping on Service Side of Water Meter inside the Building: Use any of the following piping materials for each size range:
1. NPS 4 to NPS 6: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

E. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

F. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:

1. NPS 4 and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
2. NPS 4: Type 304 stainless steel socket weld or threaded end fittings.

G. Pipe Fittings, 4” and smaller – Above ground installation
1. Wrought Copper, ANSI B16.22.
2. Cold Press Pro*Press* Fitting: (1/2” to 2”) Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22.
O-rings for copper press fittings shall be EPDM. Fittings shall have SC (Smart Connect) feature contour design.
3. 2-1/2” thru 4”: Cold Press Pro*Press* Fitting: Bronze press fittings shall conform to the material and sizing requirements of ASME B16.11 or ASME B16.15. O-rings for bronze press fittings shall be EPDM.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use stainless steel ball valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Balancing valves are specified in Division 22 Section "Plumbing Specialties."

E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Plumbing Specialties."

3.4 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Basic Materials and Methods."

B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

C. Install galvanized steel sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Basic Materials and Methods."

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Basic Materials and Methods."

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 22 Section "Plumbing Specialties."

F. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 22 Section "Plumbing Specialties."

G. Install domestic water piping level without pitch and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.5 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Basic Materials and Methods."

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 22 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

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: MSS Type 49, spring cushion rolls, if indicated.

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. Install supports according to Division 22 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.

F. Install supports for vertical steel piping every 15 feet.

G. 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.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch od.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow 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, and extend and connect to the following:

1. Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water supply 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 required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
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.

3.8 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. 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 separate report for each test, complete with diagram of portion of piping tested.
3. 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.
4. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 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 flow of hot water in each branch.
    b. Adjust calibrated balancing valves to provide flow of hot water in all branches.

5. Remove plugs used during testing of piping and plugs used 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.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Water hammer arresters.
10. Trap-seal primer valves.
11. Trap-seal primer systems.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

1.4 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

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:

    a. Ames Co.
    b. FEBCO; SPX Valves & Controls.
    c. Watts Industries, Inc.; Water Products Div.
    d. Zurn Plumbing Products Group; Wilkins Div.

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: Chrome plated.

B. Hose-Connection Vacuum Breakers:

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:

    a. Legend Valve.
    b. Watts Industries, Inc.; Water Products Div.
    c. Woodford Manufacturing Company.
    d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

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:

    a. Ames Co.
    b. FEBCO; SPX Valves & Controls.
    c. Watts Industries, Inc.; Water Products Div.
    d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Accessories:

    a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

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:
    a. FEBCO; SPX Valves & Controls.
    b. Legend Valve.
    c. Watts Industries, Inc.; Water Products Div.
    d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 3/4 (DN 20).
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

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:

    a. FEBCO; SPX Valves & Controls.
    b. Watts Industries, Inc.; Water Products Div.
    c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 8 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; [flanged] <Insert type> for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal center section, and vertical outlet flow.
8. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention Assemblies:

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:

    a. FEBCO; SPX Valves & Controls.
    b. Watts Industries, Inc.; Water Products Div.
    c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: as indicated on plans
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

D. Dual-Check-Valve Backflow Preventers:

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:

    a. FEBCO; SPX Valves & Controls.
    b. Honeywell Water Controls.
    c. Legend Valve.
    d. Mueller Co.; Water Products Div.
    e. Watts Industries, Inc.; Water Products Div.
    f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Body: Bronze with union inlet.

E. Double-Check, Detector-Assembly Backflow Preventers:

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:

    a. FEBCO; SPX Valves & Controls.
    b. Watts Industries, Inc.; Water Products Div.
    c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1048 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: as indicated on plans.
6. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved
7. End Connections: Flanged.
8. Configuration: Designed for horizontal, straight through flow.

9. Accessories:

    a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
    b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

F. Backflow-Preventer Test Kits:

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:

    a. FEBCO; SPX Valves & Controls.
    b. Watts Industries, Inc.; Water Products Div.
    c. Zurn Plumbing Products Group; Wilkins Div.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

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:

    a. Honeywell Water Controls.
    b. Watts Industries, Inc.; Water Products Div.
    c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
4. Size: as indicated on plans.
5. Design Flow Rate: see schedule on plans.
6. Design Inlet Pressure: see schedule on plans.
7. Design Outlet Pressure Setting: see schedule on plans.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

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:

    a. Armstrong International, Inc.
    b. ITT Industries; Bell & Gossett Div.
    c. NIBCO INC.
    d. Taco, Inc.

e. Watts Industries, Inc.; Water Products Div.

2. Type: Ball valve with two readout ports and memory setting indicator.
3. Body: Brass.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

C. Memory-Stop Balancing Valves:

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:

a. Crane Co.; Crane Valve Group; Jenkins Valves.
b. Crane Co.; Crane Valve Group; Stockham Div.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corp.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

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:

a. Armstrong International, Inc.
b. Honeywell Water Controls.
c. Leonard Valve Company.
d. Powers; a Watts Industries Co.
e. Symmons Industries, Inc.
f. Watts Industries, Inc.; Water Products Div.

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: 120 degrees F.
9. Valve Finish: Rough bronze.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron FDA-approved, epoxy coating 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.
    c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

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:

    a. Josam Company.
    b. PPP Inc.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.8 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

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:

    a. PPP Inc.
    b. Sioux Chief Manufacturing Company, Inc.
    c. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.

4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

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:

a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.9 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

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:

a. PPP Inc.

2. Standard: ASSE 1044,
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed-mounting steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Four.
8. Size Outlets: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Basic Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.

2. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 6 Section "Rough Carpentry."

F. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install shutoff valve on outlet if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 6 Section "Rough Carpentry."

G. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.

H. Install water hammer arresters in water piping according to PDI-WH 201.

I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 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 backflow-prevention assemblies.
4. Dual-check-valve backflow preventers.
5. Double-check, detector-assembly backflow preventers.
6. Water pressure-reducing valves.
7. Calibrated balancing valves.
8. Primary, thermostatic, water mixing valves.
9. Hose stations.
10. Supply-type, trap-seal primer valves.
11. Trap-seal primer systems.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 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 22 11 19

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. PVC: Polyvinyl chloride plastic.

C. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Manufacturers:
1) Clamp-All Corp.

2. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

a. Manufacturers:

1) MG Piping Products Co.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall Schedule 40 PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2.5 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. Fernco, Inc.
   b. Mission Rubber Co.

2. Sleeve Materials:

   a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
   b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. Mission Rubber Co.

C. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:
   a. Dresser, Inc.; DMD Div.
   b. Romac Industries, Inc.

2. Center-Sleeve Material: Stainless steel.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

D. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

   a. EBAA Iron Sales, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products; Star Fittings Div.

E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

   a. SIGMA Corp.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil, waste and vent piping NPS 6 and smaller shall be any of the following:
   1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints (non-return air plenum locations only, verify all locations prior to purchase of pipe).
   3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Underground, soil, waste, and vent piping NPS 6 and smaller shall be any of the following:
   1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   2. Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
   3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 2 Section "Sanitary Sewerage."

B. Basic piping installation requirements are specified in Division 23 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 23 Section "Basic Mechanical Materials and Methods."

E. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

I. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.

J. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

   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. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours 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 final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. 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 separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 22 13 16

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SECTION 22 13 19 - DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Roof Drains.
5. Through-penetration firestop assemblies.
6. Miscellaneous drainage piping specialties.
7. Flashing materials.
8. Grease interceptors.

B. Related Sections include the following:

1. Division 22 Section "Plumbing Fixtures" for hair interceptors.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
1. Grease interceptors.
2. Backwater valves.
3. Cleanouts.
4. Floor drains.
5. Roof Drains.
6. Through-penetration firestop assemblies.
7. Miscellaneous drainage piping specialties.
8. Flashing materials.

B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, PVC Backwater Valves

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:

a. Canplas Industries
b. Plastic Trends
c. Flo Control, Inc.

2. Approvals: BOCA, CSA, IAPMO, SBCC1
3. Size: Same as connected piping.
4. Body: PVC
5. End Connections: hubless.
6. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
7. Extension: ASTM A 74, Service class; full-size, PVC, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

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:

a. Josam Company; Josam Div.
b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
c. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Cast-Iron Wall Cleanouts:

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:

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Square, stainless-steel wall-installation frame and cover.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

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:
    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom
9. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
10. Top or Strainer Material: Nickel bronze
11. Top of Body and Strainer Finish: Nickel bronze
12. Top Shape: Square.
13. Top Loading Classification: Heavy Duty.
14. Trap Material: Cast iron.
15. Trap Pattern: Deep-seal P-trap.
16. Trap Features: Trap-seal primer valve drain connection.

2.4 ROOF DRAINS

A. Metal Roof Drains:

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:
    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.21.2M.
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Required for overflow roof drain only.
7. Outlet: Bottom.
8. Dome Material: Cast iron.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Sump Receiver: Required.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

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:

   a. ProSet Systems Inc.
   b. 3M Corporation.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.

3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.7 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.8 GREASE INTERCEPTORS

A. Grease Interceptors:

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:

   a. Applied Chemical Technology, Incorporated.
   b. Josam Company; Josam Div.
   c. Oldprecastle Precast Co.
   d. Rockford Sanitary Systems, Inc.
   e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2. Standard: ASME A112.14.3[and PDI-G101], for intercepting and retaining fats, oils, and greases from food[-preparation] wastewater.
3. Plumbing and Drainage Institute Seal: Required.
4. Body Material: Reinforced concrete.
5. Body Dimensions: See drawing detail.
6. Body Extension: Required.
7. Grease Retention Capacity: See drawing detail.
8. Inlet and Outlet Size: See drawing detail.
9. Cleanout: field installed on inlets and outlets.
10. Mounting: Below grade.
11. Operation: Manual cleaning.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 3 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Install through-penetration firestop assemblies in plastic stacks at floor penetrations.

H. Assemble open drain fittings and install with top of hub 1 inch, 2 inches above floor.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

M. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

N. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 7.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Grease interceptors.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled grease removal devices and their installation, including piping and electrical connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain grease removal devices. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 22 13 19

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SECTION 22 14 13 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Manufacturers:
1) Clamp-All Corp.

2. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

a. Manufacturers:

1) MG Piping Products Co.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall Schedule 40 PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.5 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. Fernco, Inc.
   b. Mission Rubber Co.

2. Sleeve Materials:

   a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
   b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

   a. ANACO.

D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

   a. Cascade Waterworks Mfg. Co.
   b. Romac Industries, Inc.

2. Center-Sleeve Material: Stainless steel.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:
   a. Romac Industries, Inc.
   b. Star Pipe Products; Star Fittings Div.

F. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

   a. SIGMA Corp.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints (non-return air plenum locations only, verify all locations prior to purchase of pipe).
4. Dissimilar Pipe-Material Couplings: Flexible & Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Aboveground, storm drainage piping NPS 8 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints (non-return air plenum locations only, verify all locations prior to purchase of pipe).
4. Dissimilar Pipe-Material Couplings: Flexible & Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Underground storm drainage piping NPS 6 and smaller shall be any of the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Flexible & Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

E. Underground, storm drainage piping NPS 8 and larger shall be any of the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 2 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 23 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Plumbing Specialties."

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."

E. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

G. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

I. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Install PVC storm drainage piping according to ASTM D 2665.

L. Install underground PVC storm drainage piping according to ASTM D 2321.

M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 23 Section "Valves."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 and smaller.
2. Install butterfly valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Backwater valve are specified in Division 15 Section "Plumbing Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 23 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

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. Install supports according to Division 23 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.

2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours 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.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. 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 separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 14 13

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Faucet-spout outlets.
3. Toilet seats.
4. Fixture supports.
5. Water closets.
6. Lavatories.
7. Sinks.
8. Service sinks.

B. Related Sections include the following:

1. Division 2 Section "Water Distribution" for exterior plumbing fixtures and hydrants.
2. Division 15 Section "Plumbing Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

D. FRP: Fiberglass-reinforced plastic.

E. PVC: Polyvinyl chloride plastic.

F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
4. Stainless-Steel Residential Sinks: ASME A112.19.3.
5. Vitreous-China Fixtures: ASME A112.19.2M.
6. Water-Closet, Flushometer Tank Trim: ASSE 1037.

G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.

10. Supply Fittings: ASME A112.18.1.
11. Brass Waste Fittings: ASME A112.18.2.

H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 Refer to contract documents for basics of design of plumbing fixtures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting attached to building floor substrate bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball valves if supply stops are not specified with fixture. Valves are specified in Division 23 Section "Valves."

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install toilet seats on water closets.

N. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

O. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 23 Section "Basic Mechanical Materials and Methods."

P. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00

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SECTION 22 47 00 - FUEL-FIRED WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following fuel-fired water heaters:
   1. Commercial, power-burner, storage, gas water heaters.

1.3 DEFINITIONS

A. N Gas: Natural fuel gas.

1.4 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Product Certificates: For each type of commercial water heater, signed by product manufacturer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Commercial, Gas Water Heaters:

1) Storage Tank: Five years.
2) Controls and Other Components: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS WATER HEATERS

A. Commercial, Power-Burner, Storage, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.

1. Manufacturers:
a. PVI Industries, LLC.
b. Smith, A. O. Water Products Company.
c. Lochinvar Inc.

2. Storage-Tank Construction: ASME-code steel with 150-psi working-pressure rating.

a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Lining: Phenolic coating complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

3. Factory-Installed, Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
e. Jacket: Steel with enameled finish.
f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

4. Burner: Comply with UL 795 for power-burner water heaters and for natural-gas fuel.

a. Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.

5. Temperature Control: Adjustable thermostat.
6. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
7. Special Requirements: NSF 5 construction.
8. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.
9. Capacity and Characteristics: See drawing schedule

2.2 COMPRESSION TANKS

A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Manufacturers:

a. AMTROL Inc.
b. Armstrong Pumps, Inc.
c. Smith, A. O.; Aqua-Air Div.
d. State Industries, Inc.
e. Watts Regulator Co.

2. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics:

a. Working-Pressure Rating: 150 psig.
b. Capacity Acceptable: 10 gal. minimum.
c. Air Precharge Pressure: 60 psi

2.3 WATER HEATER ACCESSORIES

A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.

B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.

C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.

D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

F. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

G. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

H. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.

I. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
2. Concrete base construction requirements are specified in Division 23 Section "Basic Mechanical Materials and Methods."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install gas water heaters according to NFPA 54.

D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.

E. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

F. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

G. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

H. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 23 Section "Plumbing Specialties" for hose-end drain valves.

J. Install thermometer on outlet piping of water heaters. Refer to Division 23 Section "Meters and Gages" for thermometers.

K. Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 23 Section "Meters and Gages" for pressure gages.

L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include

shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 23 Section "Valves" for general-duty valves and to Division 23 Section "Meters and Gages" for thermometers.

M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

N. Fill water heaters with water.

O. Charge compression tanks with air.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 1 Section "Closeout Procedures, Demonstration and Training."

END OF SECTION 22 47 00

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SECTION 23 00 00 - MECHANICAL & PLUMBING SUPPLEMENTAL REQUIREMENTS

PART 1 -GENERAL

1.1 REFERENCES

A. This entire section forms an integral part of each HVAC, Electrical, Plumbing, Fire Protection, Controls and all other related Mechanical and Electrical sections included in the 230000 and 260000 series of the specifications.

B. Conditions of the Contract and Division 1, General Requirements, apply to work of this Section. Where Paragraphs of this Section conflict with similar paragraphs of Division 1, requirements of this Section shall prevail.

C. Examine Drawings and other Sections of Specifications for requirements that affect work of this Section.

D. Attention is directed to the following specialized requirements of this Part I:

1. Article 1.7 REQUEST FOR INFORMATION (RFI) PROCEDURE. This Article describes the requirements of the Contractor when submitting RFIs.

2. Article 1.13 GUARANTEE AND 24 HOUR SERVICE. The requirement to provide a 24 hour phone number for service during the guarantee period is incorporated; also, an extended warranty to cover the full one year contractor's guarantee period starting on the date of substantial completion, even if equipment has been previously used for temporary heat or other purpose.

3. Article 1.14 RECORD DOCUMENTS. A requirement to incorporate photographs, taken during construction, of buried and concealed components is incorporated.

4. Article 1.18 SUBMITTALS. A special cover sheet for each submittal, to be filled out by the contractor, is required. A description of "Acceptable Manufacturers" is included. No other manufacturers will be considered for this project. The turn-around time X-nth requires to process submittals is defined.

1.2 DEFINITIONS

A. As used in these Sections, "provide," means "furnish and install." "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project. "Architect" means the "Prime Design Consultant," and if Ingenuity, Inc. is not the prime design consultant, the Architect may authorize Ingenuity, Inc. to act on the Architect's behalf in matters concerning the 210000, 220000, 230000 and 260000, 270000 series of specifications. "RFI" means Contractor's “Request for Information."

1.3 SCOPE

A. Perform work and provide material and equipment as shown on Drawings and/or as specified and/or indicated in this Section of the Specifications. Completely coordinate work of Sections (Divisions 21, 22, 23, 26, and 27) with work of other trades and provide a complete and fully functional installation.

B. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. It is the intent that these Specifications and Drawings are to establish minimum requirements for methods, products and equipment and to provide electrical service, distribution and systems finished, tested and ready for operation. Incidental detail not usually shown or specified, but necessary for proper installation and operation shall be included in the work and this Contractor's estimate, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each raceway and piece of equipment to minimize conflicts with other trades.

D. Give notices, file plans, obtain permits and licenses, pay fees and backcharges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

E. This project will be phased, as defined by the Owner. This will necessitate the provision of temporary valving and capping of Mechanical, Electrical, Plumbing and Fire Protection utilities. All associated appurtenances with the utilities shall be provided as part of this project.

F. The scope of electrical work shall include all labor, materials, tools, equipment and services necessary for, or incidental to proper installation and completion of the work indicated on the Drawings and stated within these Specifications.

1. Unless otherwise noted, provide labor and materials to install electrical disconnects, pushbutton stations, controllers and motor starters supplied by other trades.

2. Unless otherwise noted, provide labor and materials to make final electrical connections to motors, controllers and starters and electrical interconnections between equipment supplied by other trades.

3. Division 23 Contractor shall furnish all motor starters and disconnect switches as required by NEC for HVAC motors, unless specifically noted otherwise in the specifications or on the drawings. Motor starters and disconnect switches shall be in accordance with Division 26 Specifications.

G. These documents describe the systems required and approximately where the larger equipment is to be located. This contractor shall include allowances in his estimates to fully complete the system including all interconnecting and coordination and installation details and components and extending the system into and throughout all spaces. He shall also include allowances for startup and for making the systems fully operational, and for scope and design contingencies. Future changes in price above the GMP or selected Bid, for items not shown on these drawings will not be allowed if the system itself is shown or described in these documents. The only future changes in price that will be allowed are if new systems are added.

H. If a Guaranteed Maximum Price (GMP) has been prepared using documents prior to the issuance of the 100% Bid Documents, the Contractor shall identify any and all changes to

the documents (both drawings and specifications) that are affecting the GMP, either increasing or decreasing the GMP amount. All changes shall be numbered and circled, in both drawings and specifications. The Contractor shall also provide detailed cost back-up for all items noted above.

1.4 CONTRACT DOCUMENTS

A. Listing of Drawings does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, Site Utility and all other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of Sections (Divisions 21, 22, 23, 26, and 27) must be coordinated.

B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.

E. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.

F. Data that may be furnished electronically by the Architect (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not substitute for Architect's sealed or stamped construction documents.

1.5 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are ambiguous, advise Architect in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or ambiguities thus resolved.

B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert Architect in writing before installation. Otherwise, make changes in installed work as Architect requires within Contract Price.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specifications, this contractor shall provide that material, installation, or work which is of the higher, more stringent standard.

D. It is the requirement of the Contract Documents to have the contractor provide systems and components that are fully complete, operational and suitable for the intended use.

There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

E. In cases covered by Paragraph (D) above, where the Contractor believes he needs engineering guidance, he shall submit a sketch identifying his proposed solution and the Architect shall review and advise of disposition (refer to Article 1.7).

1.6 MODIFICATIONS IN LAYOUT

A. HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.

B. In order to obtain the Architect's desired aesthetics in spaces used by building occupants, in all such spaces, prior to installation of visible material and equipment (including access panels) review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.

C. Check Contract Documents, as well as, Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Divisions 21, 22, 23, 26, and 27 will be installed.

D. Maintain maximum headroom at all locations. All piping, duct, conduit and associated components to be as tight to underside of structure as possible.

E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C and D above. Systems shall be run in a rectilinear fashion.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval (refer to Article 1.7).

1.7 REQUESTS FOR INFORMATION (RFI’S)

A. If the RFI is a request to resolve a conflict or an ambiguity, or a request for additional detail, Contractor's RFI shall include a sketch or equivalent description of Contractor's proposed solution, in accordance with paragraphs 1.5 (E) and 1.6 (F) above.

B. To expedite the flow of RFI's, for all RFI's under Divisions 23 and 26, Contractor shall submit the attached form, or similar form including the same information, to the Architect, with copy to X-nth. Contractor shall include proposed solution in the indicated space on the form.

1.8 COORDINATION DRAWINGS

A. When included as part of the Contract Documents, there shall be full cooperation and coordination of all specialty trades.

B. The Division 21, 22, 23, 26, and 27 Contractors shall both comply fully with the requirements set forth in the “Coordination Drawings” specification section. At a minimum, this shall include the following trades:

1. Mechanical Ductwork
2. Mechanical Piping
3. Plumbing
4. Electrical
5. Fire Protection (sprinkler system)
6. Controls
7. Special Building Systems

C. Refer to the Coordination Drawings specification section for specific requirements.

D. The following work is required by, but not specified in, Division 23 and 26 and shall be performed in compliance with the appropriate Sections.

1. Excavation and backfill.
2. Concrete work, including concrete housekeeping pads and other pads and blocks for vibrating and rotating equipment, ductbank envelopes and cast-in-place manholes and handholes.
3. Cutting and patching of masonry, concrete, tile and other parts of structure, with the exception of drilling for hangers and providing holes and openings in metal decks.
4. Flashing of wall and roof penetrations.
5. Installation of access panels in floors, walls, and furred spaces or above ceilings.
6. Painting, except as specified herein.
7. Structural supports necessary to distribute loading from equipment to roof or floor, except as specified herein.
8. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing.
9. Outdoor air intake and exhaust louvers.

1.9 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of Divisions 21, 22, 23, 26, and 27. No extra payment will

be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.

1.10 EXISTING CONDITIONS AND PREPARATORY WORK

A. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or other Contracts or by the Owner. Report conditions that might affect work adversely, in writing, through Contractor to Architect via RFI. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

1.11 CODES, STANDARDS, AUTHORITIES AND PERMITS

A. Perform work strictly as required by rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have legal jurisdiction over the site.

B. Prior to commencement of work, notify State and applicable authorities as required and submit all of the applicable notifications for construction, operation and/or demolition.

C. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.

2. Air Movement and Controls Association, Inc. (AMCA)

3. American Gas Association (AGA).

4. American Society of Plumbing Engineers (ASPE).

5. Cast Iron Soil Pipe Institute (CISPI).

6. Factory Mutual Association (FM).

7. Mechanical Contractors Association (MCA).

8. Manufacturers Standardization Society (MSS).

9. National Bureau of Standards (NBS).

10. National Electrical Code (NEC).

11. National Fire Protection Association (NFPA).

12. National Sanitation Foundation (NSF).

13. Plumbing and Drainage Institute (PDI).

14. American Insurance Association (A.I.A.) (formerly National Board of Fire Underwriters).

15. Occupational Safety and Health Act (OSHA).

16. Underwriters Laboratories (UL)

17. Water Conditioning Foundation (WCF).

18. Owner’s Insurance Underwriter.

D. Material and equipment shall be listed by Underwriters' Laboratories (UL), and approved by ASME, ANSI, ASTM, and AGA for intended service.

E. Fire protection equipment shall be listed by Underwriters’ Laboratories (UL) and/or Factory Mutual (FM) approved for fire service.

F. When requirements cited in this Specification conflict with each other or with Contract Documents, the most stringent shall govern work. Architect may relax this requirement when such relaxation does not violate ruling of authorities that have jurisdiction. Approval for such relaxation shall be obtained in writing.

G. Most recent editions of applicable specifications and publications of the following organizations form part of these Contract Documents.

1. American Gas Association (AGA).

2. Air Movement and Control Association (AMCA).

3. American National Standards Institute (ANSI).

4. Air-Conditioning and Refrigeration Institute (ARI).

5. American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).

6. American Society of Mechanical Engineers (ASME).

7. American Society of Plumbing Engineers (ASPE).

8. American Society of Sanitary Engineering (ASSE).

9. American Society for Testing and Materials (ASTM).

10. American Water Works Association (AWWA).

11. Cast Iron Soil Pipe Institute (CISPI).

12. Certified Ballast Manufacturers (CMB).

13. Factory Mutual Engineering (FM).

14. Manufacturer's Standardization Society of the Valve & Fittings Industry (HSS)

15. Insulated Cable Engineers Association (ICEA).

16. Institute of Electrical and Electronics Engineers (IEEE).

17. Illuminating Engineering Society (IES).

18. Mechanical Contractors Association (MCA).

19. National Bureau of Standards (NBS).

20. National Electrical Code (NEC).

21. National Electric Manufacturers Association (NEMA).

22. National Fire Protection Association (NFPA).

23. National Sanitation Foundation (NSF).

24. Plumbing and Drainage Institute (PDI).

25. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

26. Thermal Insulation Manufacturers Association (TIMA).

27. Underwriters Laboratories (UL).

28. Water Conditioning Foundation (WCF).

H. The complete installation shall comply with the following codes:

1.	**NFPA 1**	**2018**	**Uniform Fire Code**
2.	**NFPA 13**	**2019**	**Standard for the Installation of Sprinkler Systems**
3.	**NFPA 13R**	**2019**	**Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height**
4.	**NFPA 24**	**2019**	**Standard for the Installation of Private Fire Service Mains and Their Appurtenances**
5.	**NFPA 25**	**2019**	**Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems**
6.	**NFPA 51B**	**2018**	**Standard for Fire Protection During Welding, Cutting and Other Hot Work**
7.	**NFPA 70**	**2020**	**National Electrical Code**
8.	**NFPA 72**	**2019**	**National Fire Alarm Code**
9.	**NFPA 75**	**2018**	**Standard for the Protection of Information Technology Equipment**
10.	**NFPA 90A**	**2019**	**Standard for the Installation of Air Conditioning and Ventilating Systems**

11.	**NFPA 92A**	**2018**	**Standard for Smoke – Control Systems Utilizing Barriers and Pressure Differences**
12.	**NFPA 96**	**2020**	**Standard for Ventilation Control and Fire Prevention of Commercial Cooking Operations**
13.	**NFPA 99**	**2018**	**Standard for Health Care Facilities**
14.	**NFPA 101**	**2018**	**Life Safety Code**
15.	**NFPA 110**	**2019**	**Standard for Emergency and Standby Power Systems**
16.	**NFPA 780**	**2017**	**Installation of Lightning Protection Systems**
17.	**ASME A17.1**	**2019**	**Elevator Code**

18. Americans with Disabilities Accessibility Guidelines - 1998

19.	**ANSI A117-1**	**1998**	**Accessibility Code**
20.	**AMCA (latest edition)**	**210**	**Laboratory Methods of Testing Fans for Rating Purposes**
21.	**AMCA (latest edition)**	**310**	**Reverberant Room Method for Sound Testing of Fans**
22.	**AMCA (latest edition)**	**500**	**Test Method for Louvers, Dampers, and Shutters**
23.	**ARI (latest edition)**	**410**	**Forced-Circulation Air-Cooling and Air Heating Coils**
24.	**SMACNA (latest edition)**		**Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, Sheet Metal and Air Conditioning Contractors National Association, Inc.**

25. 2023 Florida Building Code, Accessibility, 8th Edition

26. 2023 Florida Building Code, Building, 8th Edition

27. 2023 Florida Building Code, Mechanical, 8th Edition

28. 2023 Florida Building Code, Plumbing, 8th Edition

29. 2023 Florida Building Code, Fuel Gas, 8th Edition

30. 2023 Florida Building Code, Test Protocols for High Velocity Hurricane Zones, 7th Edition

31. 2023 Florida Building Code, Energy Conservation, 8th Edition

32. The Guidelines for Design and Construction of Hospitals – 2018 Edition

33. The Guidelines for Design and Construction of Residential Health Care, and Support Facilities – 2018 Edition

I. Secure and pay for all permits and inspections required by any of the Authorities Having Jurisdiction (AHJ).

1.12 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee the Work of this Section in writing for one year following the date of Substantial Completion. If the equipment is used for ventilation, temporary heat, etc. prior to initial beneficial occupancy by the Owner, the bid price shall include an extended period of warranty covering the one-year of occupancy, starting from the initial date of beneficial occupancy by the Owner. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

B. In addition to guarantee requirements of Division 1 and of Paragraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

C. Replace material and equipment that require excessive service during guarantee period as defined and as directed by Architect.

D. Provide 24-hour service beginning on the date of Substantial Completion and lasting until the termination of the guarantee period. Service shall be at no cost to the Owner. This contractor or a separate service organization can provide Service. Choice of service organization shall be subject to Architect and Owner approval. Submit name and a phone number that will be answered on a 24-hour basis each day of the week, for the duration of the service.

E. Submit copies of equipment and material warranties to Architect as part of the close-out documents before final payment.

F. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to Owner.

G. This Article shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

H. Specific Paragraphs of the Specification sections may specify warranty requirements that exceed those of this Article.

I. Use of systems provided under Divisions 21, 22, 23, 26, and 27 for temporary services and facilities shall not constitute Final Acceptance of work nor beneficial use by Owner, and shall not institute guarantee period.

J. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will suggest course of action.

1.13 RECORD DOCUMENTS

A. As work progresses and for duration of Contract, maintain a complete and dedicated set of Contract Documents (including drawings and specifications) at the job site at all times, to become the Record Documents. Record work completed and all changes from original Contract Documents clearly and accurately, including work installed as a modification or addition to the original design. This shall be updated, at a minimum weekly, and will be reviewed prior to each Pay Application approval.

B. Take photographs of all concealed equipment in gypsum board ceilings, shafts, underground (buried) piping routes and supports and other concealed, inaccessible work. At completion of work, make copies of photographs with written explanation for each photo. These shall become part of Record Documents.

C. Underground and utility work shall be located by distances to landmarks, such as building foundations. Give actual dimensions of everything installed including elevations and elevations at each change in direction.

D. Drawings shall also show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall incorporate actual manufacturer and make and model numbers of final equipment installation.

E. THE ENGINEER/ARCHITECT WILL NOT CERTIFY THE ACCURACY OF THE RECORD DRAWINGS - THIS IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

F. When required by the jurisdiction, each trade shall submit the record set for approval by the building department in a form acceptable to the department. Any document format size changes, and supplemental information required for the submittal are the responsibility of the contractor.

G. The Record Documents shall include at a minimum:

1. Actual location of existing utilities.

2. Field changes to installation that differ from original design documents.

3. Document revisions associated with RFI responses, Supplemental Instructions, Proposal Requests, and Change Orders, etc.

4. Show routing of electrical feeder conduits.

5. Show power and lighting circuiting indicating actual panel and circuit number.

H. Quality of Record Documents shall equal or exceed that of original Contract Documents.

I. The record documents shall be submitted in electronic media format to the Architect/Engineer for review and approval, prior to Application for Final Payment.

J. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in coordinated manuals with additional information describing combined operation of field assembled units, including as-built wiring diagrams. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into three sections or books as follows:

1. Directions for and sequence of operation of each item of the Mechanical and Electrical systems, e.g., air handling units, boilers, domestic water pump, generator, etc. Sequence shall list valves, switches and other devices used to start, stop and control system. Detail procedure to be followed in case of malfunctions. Include detailed approved flow diagrams of temperature control, heating, condensate, chilled water, condenser water, etc., as appropriate for systems provided. Include approved valve directory showing each valve number, location of each valve, and equipment or fixture controlled by valve.

2. Detailed maintenance and trouble shooting manuals containing data furnished by manufacturer for complete maintenance. Include copy of Engineer-approved balancing report.

3. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment. Include additional instructions necessary for implementation of first class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.

K. The manuals shall include the following and shall have an index of contents and tabs for each Specification Section and each piece of equipment specified in that Section and be provided in the order listed below, per Specification Section.

1. Copies of all approved submittals/shop drawings.

2. Manufacturer's operating and maintenance instructions and parts lists of all items or equipment. Where manufacturer's data includes several types or models, the applicable type or model shall be clearly designated.

3. Startup and shutdown procedures.

4. Flow diagrams.

5. Test records.

6. Wiring diagrams.

7. Composite electrical diagrams.

8. Owner's written acknowledgement of satisfactory completion of instruction period.

L. The operation manuals and instructions to the Owner are of prime importance and shall be provided prior to request for final payment.

M. Furnish three copies of manuals to Architect for approval and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.

N. Provide framed and glazed charts as follows (mount as directed by Owner or Architect):

1. Flow diagrams from first part of manual as described above.

2. Valve directory.

3. Lubrication chart from third part of manual.

O. Operating instructions: Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct Owner's operating personnel in any or all parts of all systems. Factory-trained personnel shall perform instructions. Owner shall determine which systems require additional instructions. Duration of instructions shall take equipment through complete cycle of operation (at least five working days). Make adjustments under operating conditions.

1.14 PROTECTION OF WORK

A. Each contractor shall be responsible for his work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment, which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plug during construction to prevent entry of obstructing material.

B. Each separate contractor shall protect the work and material of other trades that might be damaged by his work or workmen and make good all damage thus caused.

1.15 SUBMITTALS

A. This Article supplements Division 1.

B. Definitions:

1. Shop Drawings are information prepared by the Contractor to illustrate portions of the work, such as ductwork layout arrangements, in more detail than shown in the Contract Documents.

2. Coordination Drawings are detailed, large-scale layout Shop Drawings showing HVAC, Electrical, Plumbing and Fire Protection work superimposed in order to identify conflicts and ensure inter-coordination of Mechanical, Electrical, Architectural, Structural and other work.

3. Submittals are a compilation of product data cutsheets fully describing performance, size, connections, color selection, etc., as provided by the manufacturer.

C. Submittal Cover Sheet

1. Submittal data for each product shall include a copy of the following cover sheet completely filled out. Incomplete or incorrect cover sheet submittal shall constitute reason for rejection.

2. Shop drawings/submittals shall be submitted according to applicable specification section's requirements with a separate cover sheet completed for each product, rather than one cover sheet for multiple products, whether or not supplied by one manufacturer or vendor.

3. Review submittal packages for compliance with Contract Documents and then submit to Architect for review. Submit reproducible drawing and two blue- or black-line reproductions of each Shop Drawing larger than 8-1/2 x 11. Submit four sets of each smaller shop drawing. After review, reproducible original of each large Shop Drawing and three sets of each small shop drawing will be returned with reviewer's marks.

4. Submittals and shop drawings shall be submitted COMPLETE, by trade, in heavy-duty three-ring binders. Each binder shall include a Table of Contents identifying each section. Each section shall be arranged in order of specification section and tabbed accordingly. Each item submitted shall reference the article and paragraph of its specification section. Each item specified shall be addressed. If specified item will not be used, state so in submittal with brief explanation. (Example: Globe Valves - N/A, use ball and butterfly valves.) In the instance when a resubmission is necessary, resubmit only the items required; a complete resubmittal containing previously approved data is not required.

5. Submittals and/or shop drawings associated with long lead items required on this project, shall be submitted within 30 days after Notice to Proceed has been issued.

6. Provide additional copies of approved submittals/shop drawings as required for full distribution.

7. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be 1/4 inches = 1 foot 0 inch scale unless specified otherwise. Sheet Metal Shop Drawings shall be 3/8 inch = 1 foot 0 inch and shall indicate work of other Sections where physical clearances are critical and where interferences are possible. Provide larger scale details as necessary. Sheet Metal Drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls, partitions, diffusers, registers, grilles, fire dampers, sleeves and other aspects of construction as necessary for coordination. Submit one reproducible plus two prints of each shop drawing.

8. ALL FIREWALLS AND SMOKE PARTITIONS MUST BE HIGHLIGHTED ON THE SHEETMETAL DRAWINGS FOR APPROPRIATE COORDINATION.

9. Shop drawings and submittals showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.

10. Provide shop drawing submittals showing details of piping connections to ALL equipment. If connection details are not submitted and connections are found to be installed incorrectly in the field, this contractor shall reinstall them within the original contract price.

D. Acceptable Manufacturers

1. The Engineer's mechanical/electrical design for each product is based on the manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications certain Alternate Manufacturers are listed as being acceptable. The listing of a manufacturer as acceptable does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. These are acceptable only if, as a minimum, they:

   a. Meet all performance criteria listed in the schedules and outlined in the specification. For example, to be acceptable, an air-handling unit must deliver equal CFM against equal external static pressure using equal or fewer horsepower as the air handler listed in the schedules.

   b. Have identical operating characteristics to those called for in the specification. For example, a two-stroke diesel generator will not be acceptable if a four-stroke model is specified.

   c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Engineer has determined that the manufacturer's products will fit within the available space - this determination is solely the responsibility of the contractor.

   d. For rooftop mounted equipment and for equipment mounted in areas where structural matters are a consideration, the products must have a weight no greater than the product listed in the schedules or specifications.

   e. Products must adhere to all architectural considerations including but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers, lighting and plumbing fixtures - being the same size and of the same physical appearance as scheduled or specified products.

   f. All equipment shall be labeled or listed by the National Board of Underwriters Laboratories (U.L.) where such labeling or listing exists for such material.

E. Required Use of Acceptable Manufacturers on this Project:

1. Substitution of products other than those of the Acceptable Manufacturers specified herein shall not be made. Only the specified items or the comparable product by one of the specified Alternate Manufacturers shall be submitted. Products by other manufacturers shall not be used on this project.

2. Listing of a manufacturer's name for a particular material or piece of equipment does not imply acceptance of all of that manufacturer's products. Use of more than one manufacturer to supply any specific material or equipment shall have prior approval of the Architect/Engineer.

F. Deviations

1. Concerning deviations other than substitutions, proposed deviations from Contract Documents should be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of submittals/shop drawings which flags the deviation to the attention of the Architect.

2. Without letters flagging the deviation to the Architect, it is possible that the Architect may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Architect, the contractor shall hold the Architect and his consultants harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Architect has reviewed or approved submittals/shop drawings containing the deviation, and will be strictly enforced.

3. Approval of proposed deviations, if any, will be made at the discretion of the Architect.

4. Where equipment or methods different than those specified are submitted by this Contractor and approved for use by the Engineer and Owner, the installation shall be in full conformance with the intent of these Contract Documents. All costs related to the use of the different method and/or equipment shall be paid by this Contractor.

G. Submittal Dispositions: Submittals will be returned from the Engineer marked as illustrated below:

NO EXCEPTIONS TAKEN -	Submitted data is in compliance with Contract Document requirements; contractor is still required to coordinate and field verify products and installation.
MAKE CORRECTIONS NOTED -	Submitted data is generally in compliance with Contract Document requirements with minor notations; no resubmission required. Item is approved for release if engineers' notations are addressed.
REVISE AND RESUBMIT -	Submitted data contains deviations, is incomplete, or requires further clarification any of which require resubmission for confirmation; item is not approved for release.
REVIEWED FOR GENERAL CONFORMANCE WITH OUR DISCIPLINES ONLY -	Submitted data and products reviewed for compatibility with the Engineering systems. Specific product performance must be reviewed and approved by the Engineer/Architect that designed the system.
NO EXCEPTIONS TAKEN -	Submitted data is in compliance with Contract Document requirements; contractor is still required to coordinate and field verify products and installation.

H. Responsibility

1. Intent of Submittal review is to check for capacity, rating, and certain construction features. Contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other Sections. Work shall comply with submittal notations to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor shop drawing errors or deviations from requirements of Contract Documents. The Architect's/Engineer's noting of some errors while overlooking others will not excuse the Contractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.

2. INFORM SUBCONTRACTORS, MANUFACTURERS, SUPPLIERS, ETC., OF SCOPE AND LIMITED NATURE OF REVIEW PROCESS AND ENFORCE COMPLIANCE WITH CONTRACT DOCUMENTS.

a. The Engineer's obligations to review shop drawings and other submittals and to return them in a timely manner are conditioned upon the prior review and approval of the shop drawings or submittals by the Contractor as required in the construction contract and the Contractor's submittal of the shop drawings and other submittals in accordance with a written schedule distributed in advance to the Engineer identifying the dates for the submittal of the various shop drawings and submittals.

I. Schedule: Incorporate submittal review period into construction schedule so that Work is not delayed. Contractor shall assume full responsibility for delays caused by not incorporating the following submittal review time requirements into his project schedule. Working days listed reference the time in the Engineer's office. It does not include transmittal or review time of Contractor or Architect. If more than five submittals/shop drawings of a single trade are received in one week, allow at least five (5) additional working days, exclusive of transmittal time, for review, each time a submittal/shop drawing is submitted or resubmitted.

J. Multiple Re-submittals: The Engineer will review the first submittal from the contractor and respond with comments, and will review one re-submittal for the same item(s) from the contractor and respond with comments. If the contractor is required to make subsequent submittals for the same item(s) the Engineer shall be compensated by the contractor for the time to review each subsequent re-submittal. The contractor shall agree to compensate the Engineer a minimum of $500 per each re-submittal item.

1.16 UTILITY COSTS

A. The Contractor shall include all costs from the electrical, water, sewer, gas, etc., utility companies that are assessed the Owner for installation of these services. It is the responsibility of the Contractor to obtain these costs from the utility companies and include them in his Bid.

1.17 TEMPORARY/CONTINUITY OF UTILITY SERVICES

A. Refer to Division 1 - General Requirements, regarding specific requirements.

B. Provide temporary services where project construction schedule requires extended shut downs of existing equipment and/or systems. Temporary services include the necessary equipment and/or systems to maintain continuity of services. Extended shut downs are interruptions of existing services for a period of time longer than that acceptable to the Owner.

C. Coordinate work under Divisions 21, 22, 23, 26, and 27 with progress of construction so that permanent-heating/cooling system will be ready to provide temporary heating/cooling if permitted by Architect as soon as building is closed in.

D. Provide and direct labor required for attendance, operation and final restoration of permanent heating/cooling system if used for temporary heating/cooling purposes. Owner shall provide continuous direct attendance whenever permanent system is in operation prior to acceptance of permanent heating/cooling system.

E. Heating, air conditioning, humidity control and any other environmental factors shall be the responsibility of the Contractor throughout the construction period.

F. Do not interrupt existing utility services without written Owner's approval.

G. Schedule interruptions in advance, according to Owner's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

H. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on Owner's operations.

I. Contractor shall coordinate any shutdowns of existing systems as follows:

1. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days is required.

2. Minimize timeline of shutdowns of any system.

3. Provide temporary services where required and perform shutdowns and tie ins at a time convenient to Owner.

4. Contractor shall be responsible for completing and filing the Owner's shutdown notice questionnaire.

5. Perform required survey and inspection work required by the notice for shutdown.

6. All life safety systems, including but not limited to automatic sprinklers, shall be returned to service at the end of each workday, when work is being performed on the systems. It is the responsibility of the Contractor to provide all associated appurtenances necessary to ensure that the systems are in proper working condition at all times.

J. Provide all necessary material, tools, and labor as required for the provisions of temporary services.

K. Include premium time work associated with interruptions of services and/or shutdowns as necessary to avoid disruption to Owner's operations.

L. For electrical work associated with Primary power, coordinate with the Electrical Power Utility Company.

M. Complete the following form, indicating what is being included as part of this bid, and this project.

N. For work involving an independent utility company (i.e., non-owner provided utility), Contractor shall coordinate directly with the utility provider all aspects of related work, including shutdowns, tie-ins, capacity impacts, etc.

PART 2 -PRODUCTS

2.1 GENERAL

A. Refer to each specific Mechanical and Electrical section for specific details.

PART 3 -EXECUTION

3.1 SPECIAL RESPONSIBILITIES

A. Cooperate and coordinate with work of other Sections in executing work of Divisions 23 and 26.

1. Perform work such that progress of entire project including work of other Sections shall not be interfered with or delayed.

2. Provide information as requested on items furnished under Divisions 23 and 26 which shall be installed under other Sections.

3. Obtain detailed installation information from manufacturers of equipment provided under Divisions 23 and 26.

4. Obtain final rough-in dimensions or other information as needed for complete installation of items furnished under Divisions 23 and 26 or by Owner.

5. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under Divisions 23 and 26 and other Sections. Give full information so that openings required by work of Divisions 23 and 26 may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information in proper time, provide cutting and patching or have same done, at own expense and to full satisfaction of Architect.

6. Provide information as requested as to sizes, number and locations of concrete housekeeping pads necessary for floor-mounted vibrating and rotating equipment provided under Divisions 23 and 26.

7. Notify Architect of location and extent of existing piping, conduit, ductwork and equipment that interferes with new construction. In coordination with and with approval of Architect, relocate piping, ductwork and equipment to permit new work to be provided as required by Contract Documents. Remove non-functioning and abandoned piping, ductwork and equipment as directed by Architect. Dispose of or store items as requested by Architect.

B. Installation Only Items:

1. Where this Contractor is required to install items which he does not purchase, he shall coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. These trades shall be responsible for:

a. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.

b. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

2. This Contractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of this Contractor will be considered only if presented in writing within one week of their date of delivery. Unless such claims have been submitted, this Contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

C. Maintenance of equipment and systems: Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

D. Use of premises: Use of premises shall be restricted as directed by Architect and as noted below.

1. Remove and dispose of dirt and debris, and keep premises clean. During progress of work, remove equipment and unused material. Maintain building and premises in neat and clean condition, and perform cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of Architect.

2. Store materials in a manner that will maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.

3. Do not interfere with function of existing sewers and water and gas mains, electrical or mechanical systems and services. Extreme care shall be taken to prevent debris from entering pipe, ductwork and equipment. Confer with Architect as to disruption of services or other utilities due to testing or connection of new work to existing. Interruption of services shall be performed at time of day or night deemed by Owner to provide minimal interference with normal operation. Obtain Owner's approval of the method proposed for minimizing service interruption.

E. Surveys and measurements:

1. Base measurements, both horizontal and vertical, on reference points established by Contractor and be responsible for correct laying out of work.

2. Ensure clearances between all underground utilities comply with code and Authority Having Jurisdiction.

3. Prior to installation of underground utilities which connect to site utilities provided by others, verify all existing invert elevations.

4. In event of discrepancy between actual measurements and those indicated, notify Architect in writing and do not proceed with work until written instructions have been issued by Architect.

F. Fireproofing:

1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, prior to start of spray fiber work.

2. Ducts, piping and other items, which would interfere with proper application of fireproofing, shall be installed after completion of spray fiber work.

3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by trade responsible for damage and shall not constitute grounds for extra cost to Owner.

G. Airbound Systems

1. If, after plant is in operation, any piping systems, coils or other apparatus are stratified or air bound (by vacuum or pressure), they shall be re-piped with new approved and necessary fittings, air vents, or vacuum breakers at no extra cost to the Owner. If connections are concealed in furring, floors, or ceilings, this trade shall bear all expenses of cutting, patching and refinishing construction and finish, leaving same in as good condition as before it was disturbed.

H. Miscellaneous

1. Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving mechanical and/or electrical equipment on and around site,

2. to correct the deficiency with his own forces and back charge this Contractor.

3.2 HEALTHCARE PHASING AND CONSTRUCTION CONFINEMENT SYSTEM

A. Provide necessary phasing of work and construction confinement system. The Contractor must coordinate with the facility's Infection Control Risk Assessment (ICRA) evaluation/team for this project and conform with all necessary steps required to be implemented. Work required by the Contractor to be implemented includes, but is not limited to, the following:

1. Coordinate work schedule with facility, as after-hours work may be required.

2. Provide Mechanical, Electrical, Plumbing and Fire Protection phasing in accordance with requirements of the Contract Documents.

3. Isolation of existing HVAC system at construction zone to prevent contamination of duct system.

4. Providing critical barriers and construction vestibules to separate the occupied zones from the construction zone.

5. Maintaining negative air pressure within construction zone and/or construction vestibule which in conjunction with temporary barriers controls the spread of dust fumes and debris: construction confinement system.

6. Provision of temporary 100% outside air (cooling/heating) units to provide make-up air to occupied zone adjacent to construction zone.

7. Maintain air flow from clean to less clean areas.

8. Monitoring and logging differential pressure at construction zones. Provision of a visual indicator of differential pressure. Provision of a log of pressure readings indicating pressure at the beginning, middle and end of each workday.

9. Executing work by methods to minimize raising dust from construction operations.

10. Follow all hospital regulations for work performed within sterile areas including “gowning” procedures and introduction of building materials.

11. Minimizing noise and other disturbances to the existing facility.

12. Provide means to move demolition and construction materials without passing through occupied zones.

13. Materials that have to pass through occupied zones shall be contained in sealed containers.

14. Keep at the jobsite a copy of the Infection Control Risk Assessment (ICRA) at all times during construction.

15. The Contractor shall coordinate work hours with the facility to provide work in sensitive areas. Provide night and weekend work schedules when required by the facility so that construction does not adversely affect the operation of the existing facility.

3.3 MATERIALS AND WORKMANSHIP

A. Work shall be neat and rectilinear. Ductwork, piping, conduit, etc., shall run concealed except in mechanical rooms and areas where no hung ceiling exists. Install material and equipment as required by manufacturers. Installation shall operate safely and without leakage, undue wear, noise, vibration, corrosion or water hammer. Work shall be properly and effectively protected, and pipe and duct openings shall be temporarily closed to prevent obstruction and damage before completion.

B. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation.

C. Finish of materials, components and equipment shall be as approved by Architect and shall be resistant to corrosion and weather as necessary.

D. Owner will not be responsible for material and equipment before testing, commissioning, and acceptance.

3.4 WELDING

A. Weld only by approved acetylene or electric welding processes and welders shall hold certificate from approved insurance company.

B. Conduct test to demonstrate suitability of procedures to be used in making welds, which conform to specified requirements.

C. Specification for welding procedure shall meet requirements of Welding Qualifications, Section IX, ASME Boiler and Pressure Vessel Code and ANSI B31.1.

D. Align components. No strain shall be placed on weld during welding. No part of pipe shall be offset more than 20% of thickness. Set flanges and branches properly.

E. Welder and Brazing Qualification:

1. Test welders to demonstrate ability to make acceptable welds. Tests conducted for qualification of welder for work under one Division or Section shall not necessarily qualify welder for work under another Division or Section.

2. Tests shall be as prescribed for welder qualification in Section IX of the ASME code.

3. Records of such tests shall be as follows: Each welder shall be assigned an identifying number, letter or symbol. Identifying mark shall be stamped adjacent to welds made by this welder. Identification shall be at top of horizontal piping and at front of vertical piping.

4. Maintain record of welders employed, showing dates and results of tests and identifying mark assigned to each welder. Certify records and make them accessible to Owner's project representative and/or project manager. Before completion of project, one copy of records shall be turned over to Owner.

5. No qualification shall be older than three years when welder commences work on this project. If welder has not welded in required welding process for a period of six months, he shall be re-certified.

F. Welding Tests

1. As designated by Architect, remove welds for destructive testing or for testing by non-destructive means. Tests shall be as determined by Architect.

2. If, in Architect's opinion, welds so tested do not meet requirements of Sections VIII and IX of ASME, then the Contractor shall pay for the costs of the tests. Remove welds welded by that welder, at no cost to the Owner. Rewelding shall be performed by qualified welder other than welder whose welds did not pass test. Welders whose welds were defective shall not be employed on site for remainder of project.

3. Welding of stanchions, brackets, anchors and other welding not performed on pipe joints shall be in accordance with requirements of AWS specifications and requirements.

G. Medical Gas Brazing Certification:

1. Submit a copy of Brazing Qualification as required by NFPA 99 ANSI/ASSE Standard 6010, Professional Qualification Standards for Medical Gas and Vacuum System Installers.

3.5 CEILING ACCESS AND ACCESS PANELS

A. Access panels are generally not shown on the drawings, but they are required to be provided by Contractor.

B. Provide proper access to materials and equipment that require inspection, replacement, repair or service, and coordinate their delivery with the installing Trade. If proper access cannot be provided, confer with Architect as to best method of approach for minimizing effect of reduced access which may result.

C. The maximum distance from the ceiling line to serviceable equipment (i.e., air terminal boxes, valve handles, volume damper handles, etc.) shall be 24 inches unobstructed, unless otherwise noted on the drawings.

D. Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment and deliver to a representative of the installing Trade. Furnish and install distinctively colored buttons (color as selected by Architect) in finished ceiling to identify all access panels.

E. Ceilings consisting of lay-in or removable splined tiles do not require access panels. Fire, control dampers, valves and equipment located above ceiling shall have location marked with color-coded identification screws attached to the ceiling “grid.” Location shall be noted on record drawings.

F. Furnish access panels for installation under other Sections where fire dampers, volume dampers, controls, shut-off valves, control valves, check valves, or other items installed under Divisions 23 and 26 require access and are concealed in floor, wall, furred space or above ceiling. Access panels shall be by Milcor, Knapp, Nystorm or Inland Steel; coordinate selection with other Sections supplying similar access panels. Color of panel shall be selected by the Architect.

G. Access panels shall have same fire rating classification as surface penetrated. Rated access panels must have U.L. Label.

H. Panels shall be at least 12 inches x 12 inches; access panels at equipment (VAV boxes, fan boxes and others) shall be at least 18 inches x 18 inches.

3.6 PENETRATIONS AND SLEEVES

A. General

1. Lay out penetration and sleeve openings in advance, to permit provision in work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed.

2. Provide sleeves and packing materials at all penetrations of foundations, walls, slabs (except on-grade), partitions and floors. Sleeves shall meet U.L. rated assemblies requirements and materials requirements of these specifications.

3. Sleeves that penetrate outside walls, basement slabs, footings and beams shall be waterproof.

4. Coordinate work carefully with architectural and structural work. Provide core drilling as necessary if walls are poured, or otherwise constructed, without sleeves and a wall penetration is required. Provide core drilling as required for penetrations of existing construction. Do not penetrate structural members without Structural Engineer's/Architect's approval.

5. Sleeves for insulated pipe and duct in non-fire rated construction shall accommodate continuous insulation without compression. Sleeves and/or penetrations in fire rated construction shall be packed with fire rated material which shall maintain the fire rating of the wall. Seal ends of penetrations to provide continuous vapor barrier where insulation is interrupted.

6. Submit a list of the U.L. Listed details that the Contractor intends on using on this project, in all rated walls.

7. Where pipes, etc., passing through openings are exposed in finished rooms, finishes of filling materials shall match and be flush with adjoining floor, ceiling, and wall finishes.

8. Identify unused sleeves and slots for future installation.

9. Fill slots, sleeves and other openings in floors or walls if not used. Fill spaces in openings after installation of pipe, duct, conduit or cable.

10. Fill for floor penetrations shall prevent passage of water, smoke, fire, and fumes. Fill shall be fire resistant in fire floors and walls, and shall prevent passage of air, smoke and fumes.

11. Sleeves through floors shall be watertight and shall extend 2 inches above floor surface.

12. Submit and coordinate with all trades complete penetration layout drawings showing all openings in building structural members including floor slabs, walls, bearing walls, foundation walls, shear walls, roof penetrations, etc. Indicate and locate, by dimension, all openings that shall be sleeved. Drawings shall be approved by Structural Engineer prior to the preparation of any opening in a structural member. Provide 24 gauge galvanized steel sleeves for all walls, floors, including foundation, stem and exterior walls.

13. All penetrations into libraries, auditoriums, conference rooms, sleep rooms, etc., must utilize an acoustical sealant in addition to any other sealants required for wall ratings.

14. Contractor shall maintain complete integrity of all completed waterproofing, weatherproofing, fire rating, and penetrations during construction.

B. Pipe and Conduit Sleeves

1. Annular space between pipe/conduit and sleeve shall be at least 1/4 inch.

2. Sleeves are not required for slabs-on-grade unless specified otherwise.

3. Sleeves and packing materials, through rated firewalls and smoke partitions, shall maintain fire rating of construction penetrated.

4. Do not support piping risers or conduit on sleeves.

5. Where pipe penetrations occur through exterior walls into building spaces, use steel pipe sleeves with integral water stop, type "WS" wall sleeves by Thunderline Corporation or approved equal. Seal annular space between sleeves and pipe with "Link-Seal" modular wall and casing seals by Thunderline Corporation, or sealing system by another manufacturer approved as equal by Architect. Where "Link-Seals" are used with insulated pipes, butt insulation against seals on both sides.

6. Penetrations through gypsum board walls do not require flexible couplings and/or sleeves. Where flexible couplings are used through non-frangible walls, provide one coupling on each side of the wall penetrated, within 1 foot from the face of the wall.

C. Duct Sleeves and Prepared Openings

1. Provide duct sleeves for round ducts 15 inches and smaller; provide prepared, framed openings for round ducts larger than 15 inches and for square, rectangular and flat oval ducts, except as specified otherwise. Sleeves shall meet SMACNA requirements.

2. Provide sleeves for ducts through 1-, 2- or 3-hour fire-rated construction and smoke partitions, regardless of size and shape of ducts. Sleeves shall maintain fire rating of construction penetrated. Sleeve and seal materials, construction and clearances shall meet requirements of SMACNA Fire Damper and Heat Stop Guide for Air Handling Systems.

3. Prepared openings shall be framed to provide 1 inch clearance between framing and duct or duct insulation in non-rated partitions.

4. All duct penetrations through concrete floors in mechanical rooms shall have 2 inches high water stopped curbs surrounding the openings. This applies to mechanical rooms above the lowest floor level.

5. Trim duct penetrations exposed in finished areas with 2 inches wide galvanized or aluminum trim collars properly sized to fit the duct. Collars to be same gauge as duct, prime finish unless noted otherwise. Finished areas shall not include mechanical rooms, janitor’s closets, storage rooms, etc., unless suspended ceilings are specified.

D. Installation Testing, Listings and Approvals

1. Installation shall meet material manufacturer's recommendations exactly, particularly regarding safety, ventilation, removal of foreign materials and other details of installation. Dam openings as recommended. Remove flammable materials used for damming and forming seals in fire-rated construction.

2. Sleeve penetration methods shall be water- and gas-tight and shall meet requirements of ASTM E-119 Standard Methods of Fire Tests of Building Construction and Materials.

3. Fire-stop penetration seal methods and materials shall be FM-approved and UL-listed as applicable.

4. Inspect foamed sealant to ensure manufacturer's optimum cell structure and color ranges.

3.7 ANCHORS AND INSERTS

A. Provide anchors as necessary for attachment of equipment supports and hangers. Anchors shall be iron or steel inserts of type to receive machine bolt head or nut after installation.

B. Inserts shall permit adjustment of bolt in one horizontal direction and shall develop strength of bolt when installed in properly cured concrete.

C. Inserts drilled and spaced after concrete pour shall be steel shell with plug type, not depending on soft lead for holding power.

3.8 EQUIPMENT SUPPORTS AND GUARDS

A. Provide all supporting steel not indicated on the structural drawings as required for the installation of equipment and materials, including angles, channels, beams, hangers, etc. Do not support equipment or piping from metal decking.

B. Provide equipment guards over belt driven assemblies, pump shafts, exposed fans and elsewhere as indicated in this specification or required by code.

C. Where guards are not furnished factory made or integral with equipment, they shall be constructed by the Contractor.

3.9 ESCUTCHEONS

A. Install escutcheons around exposed pipe passing through finished floor, floor, wall, or ceiling. Escutcheons shall be heavy cast brass, chromium-plated, adjustable, and shall be of sufficient outside diameter to cover sleeve opening and shall fit snugly around pipe and flush against floor or wall surface.

3.10 CORE DRILLING

A. Core drilling is to be avoided.

B. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc.

C. Where core drilling is unavoidable, or required by renovation projects, locate all required openings prior to coring and submit to Architect for review.

D. Coordinate openings with General Contractor/Construction Manager and all other trades.

E. Core drilling is to be provided by the Contractor for General Construction, not by the M/E subcontractors.

F. Do not disturb existing systems. Protect all areas from damage of any type.

G. Thoroughly investigate existing conditions in vicinity of required opening prior to coring.

3.11 MISCELLANEOUS TESTING AND BALANCING

A. Tests for piping systems and equipment shall be performed as specified in their respective specification sections.

B. No part of any underground work shall be covered until after it is inspected, tested, approved, and photographed.

C. Provide all equipment required for testing, including fittings for additional openings as required.

D. Notify the Architect and any Inspectors required to observe the test, at least 48 hours prior to when the test is ready to be performed.

E. The General Contractor is responsible for certifying in writing, the results of all testing of systems and equipment in this contract. These written results will be required at project close-out.

F. Include description and what portion of the system has been tested. Record date, time, test medium and pressure used, name and title of the person certifying the test. This person shall sign the certification. Forms and data must be legible.

G. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or materials as necessary, and repeat the inspection and test. Make repairs with new materials. No caulking of holes or screwed joints will be allowed.

H. Maintain complete records at the job site of all testing that has been certified. At completion of the project, include in the instruction manuals clearly legible copies of all test approval records and certification.

I. Balancing of the various systems shall be in accordance with those specific balancing specification sections.

J. Balance the entire new water distribution system. Set all balancing valves for proper flow control of all circulating water.

K. All flushing valves, pressure regulating valves, or other regulating devices shall be adjusted for proper balancing and flow to the plumbing fixture and/or equipment.

L. If the exterior domestic water supply is also serving as a source for fire protection, either exterior or interior or both, it shall be tested according to the fire protection system as herein specified.

3.12 ELECTRICAL TESTS

A. Contractor shall be responsible for all equipment required for testing.

B. On completion of work all systems installed shall test entirely free of grounds and short circuits. Before the systems are energized, perform continuity test to insure proper cable connection. Perform insulation-resistance test on each feeder conductor with respect to

ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute for 480 volt equipment and 500 volts dc for 1 minute for 120 and 208 volt equipment. Evaluate results by comparison with cables of same length and type. Investigate values less than 50 megohms. Provide test report to the Engineer. Include copies of all test results in the Operation and Maintenance Manuals.

C. Feeder unbalance measurements shall be made after the systems are in normal use by the Owner. All unbalance greater than 10% shall be corrected by this Contractor.

D. Grounding system in patient care areas shall be tested in accordance with NFPA 99 requirements. The effectiveness of the grounding system shall be determined by voltage measurements and impedance measurements and shall include all receptacles and metal conductive surfaces likely to become energized within the patient vicinity. Provide test report to the Engineer using the attached form.

E. Receptacle testing in patient care areas shall include the following:

1. The physical integrity of each receptacle shall be confirmed by visual inspection.

2. The continuity of the grounding circuit in each receptacle shall be verified.

3. Correct polarity of the hot and neutral connections in each receptacle shall be confirmed.

4. The retention force of each electrical receptacle shall be not less than 115 grams (4 oz.).

3.13 DELIVERY, STORAGE AND HANDLING

A. Protect equipment/materials from damage during shipping, storage, handling and installation. Delivery equipment/materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. The Contractor shall provide for enclosed storage, when equipment/materials are stored on-site and prior to building "dry-in", to prevent any damage resulting from inclement weather or construction traffic. Sheet metal/specialties shall not be stored outdoors.

C. Equipment exposed to weather during shipping and/or storage on site shall be plastic shrink-wrapped by the manufacturer to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation.

D. Prevent dirt and construction debris from accumulating inside equipment (including pipe and conduit, ductwork, fittings, etc.).

E. Equipment/materials, stored or installed, found to be damaged shall be replaced with new by the Contractor, to the satisfaction of the Owner and at no additional expense. Do not store equipment with PVC material with exposure to direct sunlight.

F. Equipment/materials shall be handled and installed in accordance with manufacturer's instructions.

3.14 PROVISION AND INSTALLATION OF EQUIPMENT

A. For all equipment installed external to the building whether on roofs, supports, grade, etc., the installation must comply with wind loading and impact requirements of the applicable codes for this project site.

B. All equipment being furnished on this project, shall be certified by the manufacturer that the equipment item meets the applicable seismic, wind, earthquake, and hurricane impact requirements as set forth by the Authority Having Jurisdiction overseeing this project, and as defined in the following codes:

1. Florida Building Code – Section 1626 High Velocity Hurricane Zones impact Tests for Windborne Debris

2. Florida Building Code – Section 419 Hospitals “Protection from Impact”

3. International Building Code - Section 1609 “Wind Loads”

4. International Building Code – Section 1621 “Earthquake Loads”

C. Equipment furnished for use in Florida shall be certified to meet the large and small missile impact test as defined in the Florida Building Code.

D. Compliance with the above Paragraphs B and C can be reduced and/or eliminated if the equipment being provided is located inside a structural building enclosure, designed by a licensed professional Architect and Structural Engineer.

E. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways, to satisfaction of Architect and in accordance with code requirements. Installation shall permit clearance for access to equipment for repair, servicing and replacement.

F. Install equipment so as to properly distribute equipment loads on building structural members provided for equipment support under other Sections. Roof-mounted equipment shall be installed and supported on structural steel provided under other Sections.

G. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall or ceiling mounting of equipment as required.

H. Provide steel supports and hardware for proper installation of hangers, anchors, guides, etc.

I. Provide cuts, weights, and other pertinent data required for proper coordination of equipment support provisions and installation.

J. Structural steel and hardware shall conform to Standard Specifications of ASTM; use of steel and hardware shall conform to requirements of Section Five of Code of Practice of American Institute of Steel Construction.

K. If it is determined that in order to install equipment in an existing space, disassembling of the equipment will be required, the Architect shall be notified immediately, prior to ordering equipment. Confirmation that equipment factory warranties will not be voided

shall be confirmed in writing. Arrangements for factory-authorized assembly at the job site shall then be made and be considered part of the construction cost.

L. No piping or ductwork shall pass over electrical apparatus. Piping, ductwork or equipment installed in dedicated electrical spaces as defined in NFPA shall be relocated at no additional expense.

M. Wherever the installation of this Contractor's equipment destroys the radiological integrity of a wall, floor, or ceiling, this Contractor shall be responsible to provide suitable lead shielding to maintain that integrity. Coordinate these requirements with the General Contractor.

N. Route all piping and conduit concealed in walls or above ceiling (exceptions: Mechanical/Electrical Rooms), unless noted otherwise.

O. Contractor shall label all reheat coil access doors with actual reheat coil number with indelible marker.

3.15 IDENTIFICATION

A. After painting and/or covering is completed, identify all equipment and piping as hereinafter indicated. Locate identification as conspicuously as possible except where such would distract from the finished area.

	PIPING	**VALVES**
1.	**Cold Water**	**CW-1, CW-2, CW-3, etc.**
2.	**Hot Water (Domestic)**	**HW-1, HW-2, HW-3, etc.**
3.	**Hot Water Return (Domestic)**	**HR-1, HR-2, HR-3, etc.**
4.	**Heating Water Supply (HWS)**	**HWS-1, HWS-2, HWS-3, etc.**
5.	**Heating Water Return (HWR)**	**HWS-1, HWS-2, HWS-3, etc.**
6.	**Gas**	**GAS-1, GAS-2, GAS-3, etc.**
7.	**Fuel Oil Supply (FOS)**	**FOS-1, FOS-2, FOS-3, etc.**
8.	**Fuel Oil Return (FOR)**	**FOR-1, FOR-2, FOR-3, etc.**
9.	**Storm**	**N/A**
10.	**Grease Water**	**N/A**
11.	**Medical Air**	**Refer to Section 15213**
12.	**Non Potable Water**	**NPW-1, NPW-2, NPW-3, etc.**
13.	**Fire Protection**	**FP-1, FP-2, FP-3, etc.**

B. Identify all major equipment, including air handling units, rooftop units, pumps, fans, boilers, chillers, heat exchangers, water heaters, water softeners, fire and jockey pumps, booster pumps, recirculating pumps, tanks, etc.

C. Identify equipment by stenciling equipment number and service in 2 inch high letters with 1 coat of black enamel paint.

D. Identify piping not less than once every 20 feet 0 inches, not less than once in each room, at each branch, adjacent to each access door or panel, at each valve and where exposed piping passes through walls and floors.

E. Place flow directional arrows at each pipe identification location.

F. Identify piping by stenciling with 1 coat of black enamel paint. Height of lettering to be same as pipe diameter, up to a maximum of 1 inch in height. When finished color of piping is dark, stenciling to be on white background.

G. Valve number shall be prefixed with the corresponding piping system identification letters.

H. Furnish a typewritten chart indicating equipment and areas supplied by each number valve and incorporate into Instructional Manual.

I. Furnish a typewritten chart together with color code identification and location of all access panels serving equipment and valves. This includes the location of color-coded identification screws located in accessible ceilings. Incorporate chart into Instruction Manual.

J. Furnish a typewritten chart including valve numbers, specific service and location for all valves (valve numbers shall coincide with brass valve tags). Incorporate chart into Operations and Maintenance Manual.

K. Identify control equipment with laminated plastic nameplates 1/8 inch thick by approximately 1-1/2 inches X 4 inches with 1/2 inch high lettering. Face of plastic shall be black with white letters.

L. Motor nameplates shall be located for easy reading. Relocate or provide new nameplates on motors if they are not located for easy reading.

M. Label all fire damper access doors “FD” and all fire/smoke dampers “FSD”.

3.16 LUBRICATION

A. Upon completion of the work and before turning over to the Owner, clean and lubricate all bearings except sealed and permanently lubricated bearings. Use only lubricant recommended by the manufacturer.

B. Contractor is responsible for maintaining lubrication of all mechanical equipment under his contract until work is accepted by Owner.

C. Furnish a typewritten chart with each piece of equipment listed, itemizing locations for lubrication and recommended periods for lubrication. Incorporate chart in Lubrication Manual and Instruction Manual.

D. Furnish to the Architect for approval, three typewritten lubrication manuals in loose leaf binders. One approved copy shall be returned to the Contractor for his use during the Owner instruction period. At the end of this period it shall be returned to the Architect.

E. Lubrication manual shall consist of a separate page for each item of equipment requiring lubrication, listing locations for lubrication, lubricant required, recommended periods for lubrication, date last lubricated, and spaces for recording periodic lubrication.

3.17 PAINTING

A. Equipment installed shall have shop coat of non-lead gray paint. Hangers and supports shall have one coat of non-lead red primer. Machinery such as pumps, fans, etc., shall be stenciled with equipment name. Stencil shall be at least 6 inches high for large

equipment, 2 inches high for small equipment. Finish painting, including painting of various piping and duct systems, shall be specified under other Sections.

B. Note requirement for Architect's approval invoked under Article 3.2 MATERIALS AND WORKMANSHIP regarding finish of material and equipment which are visible or subject to corrosive or atmospheric conditions.

C. All exposed equipment, piping, hangers, etc., shall be painted by the Contractor. Confirm with Owner the color scheme prior to commencing with painting. Unless otherwise directed, each system shall be painted according to the following schedule:

SYSTEM	COLOR
Condensate (Steam)	**Yellow**
Domestic Hot Water	**Orange**
Domestic Cold Water	**Yellow**
Sanitary Waste and Vent	**Green**
Hot Water Supply & Return	**Green**
Gas	**Blue**
Automatic Sprinkler	**Orange**
Vents/Drains	**Yellow**
Condenser Water	**Red**
Fuel Oil	**Red**
	Brown
	Green
	Gray

Note: Paint manufacturer numbers may differ. A direct match is not required.

D. Furnish all equipment with factory applied prime finish, unless otherwise specified.

E. If the factory finish on any equipment furnished by the Contractor is damaged in shipment or during construction of the building, the equipment shall be refinished by the Contractor to the satisfaction of the Architect.

F. Furnish one can of aerosol-free touch-up paint for each different color factory finish which is to be the final finished surface of the product.

3.18 EXPANSION PROVISIONS

A. Installation of piping must allow for expansion using offsets, loops, swing joints, expansion joints, etc., as necessary to prevent undue strain. Take-offs from mains to run-outs shall not have less than a three-elbow swings.

B. Mains and risers with loops or offsets shall be securely anchored to structure so as to impart expansion toward loops or offsets. Anchors shall be constructed of heavy forged wrought iron, secured to pipe and to structure. Provide vibration isolation as required.

C. Provide pipe alignment guides as required to guide expanding pipe to move freely from anchor points toward expansion joints, offsets, etc.

3.19 CLEANING

A. Cleaning shall be performed prior to system start-up.

B. Ductwork

1. Ducts shall be thoroughly cleaned so that no dirt or dust will be discharged from diffusers, registers or grilles, when system is operated.

2. Clean all ductwork both internally and externally to remove all dirt, plaster dust or other foreign materials. When external surfaces of ductwork are rusted, clean and restore surfaces to original condition.

3. Provide temporary connections required for cleaning. Provide cheesecloth for openings during cleaning.

4. Replace filters prior to final inspection and testing.

C. Piping

1. General:

a. After all piping systems have been pressure tested and approved for tightness, flush and clean piping as specified and as required by codes.

b. Furnish pipe cleaning chemicals, chemical feed equipment, materials and labor necessary to flush and clean piping.

c. Permanently install necessary chemical injection fittings complete with stop valves.

d. Monitor the water temperatures and prevent the heat generated by the pump circulating the water from causing the water temperature to exceed the temperature ratings of the pipe, pumps, and other components of the piping system during the flushing and cleaning process.

e. Contractor to provide a portable temporary pumping apparatus for the purpose of flushing and cleaning. Pump shall be adequate to provide the required velocities necessary for the process.

f. When external surfaces of piping are rusted, clean and restore surfaces to original condition.

2. Flushing:

a. All water side equipment control valves, strainers, etc., shall be bypassed prior to and during the flushing process.

b. Flush all water, steam and condensate systems clear of all dirt and foreign matter with all pumps bypassed. All flushing to be at a circulation rate of 6 f.p.s.

c. Maintain continuous blowdown and make-up, as required during flushing operation.

d. Once flushing is complete and prior to cleaning, all final connections to equipment shall be performed.

e. Water samples taken from the system during flushing shall determine when the system is ready for the cleaning process.

3. Cleaning:

a. Clean all pipeline strainer baskets and return to original condition or replace with new baskets prior to the pipe cleaning process.

b. The cleaning chemicals shall be designed to remove deposition from construction, such as pipe dope, oils, loose mill scale, and other extraneous silt and mud. The products shall inhibit corrosion of the various metals in the system and shall be safe to handle and use with normal chemical safety equipment, i.e., gloves and safety glasses. Effectiveness of the product shall be such that the water need only be at ambient temperatures.

c. During the cleaning procedure, remove strainers, automatic air vents, flow regulators and any other item that would be affected by the clean and flush procedure. All control valves and coils should be set up for wide open, full flow.

d. After initial flushing of a system, use portable pumping apparatus for a continuous 24 hour circulation of a cold water detergent equal to Nalco 2567 cleaner.

e. After circulating for the prescribed time, systems shall then be drained and flushed until the total alkalinity or conductivity of the rinse water is not more than 20% higher than the readings for the make-up water. Refill with clean water, and treat with scale and corrosion inhibitor. Contractor shall furnish the chemicals, supervise the cleaning, test the water after flushing, and shall provide a report that certifies successful cleaning and flushing of the piping.

D. Equipment

1. After completion of project, clean the exterior surface of all equipment, including concrete residue, dirt, paint residue, etc.

2. Clean all equipment and plumbing fixtures, as recommended by manufacturer.

3. Thoroughly disinfect all water heating equipment and the complete new domestic water piping system according to Department of Health requirements.

4. All dirt, plaster dust and other foreign matter shall be blown and/or cleaned from coils, terminal devices, diffusers, registers, and grilles.

5. Thoroughly clean equipment of all stains, paint spots, dirt, and dust. Remove all temporary labels not used for instruction or operation.

3.20 DEMOLITION

A. Refer to all drawings for general description of areas requiring demolition.

B. Refer to General Contractor's/Construction Manager's Instructions for all existing equipment and materials that shall remain the property of the Owner.

C. Items of value which are not directed to be returned to the Owner, shall become the property of the Contractor. Storage or sale of items on the project site is prohibited.

D. Protection: Ensure the safe passage of persons in and around the building during demolition. Prevent injury to persons and damage to property. Provide adequate shoring and bracing to prevent collapse. Immediately repair damaged property to the condition before being damaged. Take effective measures to prevent windblown dust.

E. Utilities: Maintain all utilities except those requiring removal or relocation. Keep utilities in service and protect from damage. Do not interrupt utilities serving used areas without first obtaining permission from the utility company and the Owner. Provide temporary services as required.

F. Except as noted otherwise, remove from the premises, all materials and equipment removed in the demolition work.

3.21 PROJECT CLOSE-OUT PROCEDURE

A. General

1. The requirements of Divisions 23 and 26 are in addition to and supplement the requirements outlined in the General Conditions and Division 1.

2. It shall be each Contractor's responsibility to personally hand-deliver all of the required project close-out checklist items and to obtain Owner's authorized representative(s) signed receipt on all items requiring Owner sign-off.

B. Record Drawings (As-Builts):

1. Refer to Article 1.14 in this section for specific requirements regarding Record Drawings.

C. Project Close-Out Checklist

1. Review requirements of each section of the specifications and submit for approval to Architect the sign-off forms which shall become the project close-out checklist. These, at a minimum, shall include the following information shown in attached Project Closeout Checklist Example. The Architect and/or Owner may incorporate additional specific items to the following checklist which shall become part of the project requirements.

2. Close-Out Checklist Example.

END OF SECTION 23 00 00

SECTION 23 05 00 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Mechanical demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. 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 thickness or specific material is 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.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
2. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
3. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC PVC CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. 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 Coordination Drawings.

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 to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed exposed-rivet concealed or exposed-rivet hinge and set screw or spring clips.
g. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
h. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. 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 (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
   b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

      1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 9.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. 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 the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use minimum 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 23 05 00

SECTION 23 05 13 – 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 ac 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 requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

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: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.

E. Stator: Copper windings unless otherwise indicated.

F. Rotor: Squirrel cage unless otherwise indicated.

G. Bearings: Shielded, prelubricated or regreasable ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating unless otherwise indicated.

I. Insulation: Class F unless otherwise indicated.

J. 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.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

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. Energy- and 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.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.25 minimum service factor.

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 23 11 23

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SECTION 23 05 19 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following meters and gages for mechanical systems:

1. Thermometers.
2. Gages.
3. Test plugs.
4. Thermal-energy meters.

B. Related Sections include the following:

1. Division 2 Section "Water Distribution" for domestic and fire-protection water service meters outside the building.
2. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer, gage and flowmeter, signed by product manufacturer.

D. Operation and Maintenance Data: For flowmeters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or brass, 9 inches long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. Ernst Gage Co.
2. Eugene Ernst Products Co.
3. Marsh Bellofram.
4. Miljoco Corp.
5. Trerice, H. O. Co.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
7. Winters Instruments.

B. Case: Plastic, 9 inches long.

C. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Metal, for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 DUCT-TYPE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. Miljoco Corp.
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.

B. Case: Metal or plastic, 7 inches long.

C. Tube: Red or blue reading, mercury or organic filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Metal, for installation in mounting bracket and of length to suit installation.

H. Mounting Bracket: Flanged fitting for attachment to duct and made to hold thermometer stem.

I. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.5 THERMOWELLS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Palmer - Wahl Instruments Inc.
4. Tel-Tru Manufacturing Company.

5. Trerice, H. O. Co.
6. Weiss Instruments, Inc.
7. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.6 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Palmer - Wahl Instruments Inc.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, drawn steel or cast aluminum 6-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Metal
9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.

1. Case: Dry type, drawn steel or cast aluminum, 6-inch diameter with holes for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Metal.
9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure
11. Range for Fluids under Pressure: Two times operating pressure.

D. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.7 TEST PLUGS

A. Manufacturers:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:
1. Inlet and outlet of each thermal storage tank.
2. Outside-air, return-air, and mixed-air ducts.

B. Install direct-mounting, vapor-actuated dial thermometers in the following locations:
1. .
2. Inlet and outlet of each hydronic heat-recovery unit.
3. Inlet and outlet of each thermal storage tank.

C. Install remote-mounting, vapor-actuated dial thermometers in the following locations:
   1. Inlet and outlet of each hydronic heat-recovery unit.
   2. Inlet and outlet of each thermal storage tank.

D. Install bimetallic-actuated dial thermometers in the following locations:
   1. Inlet and outlet of each hydronic heat-recovery unit.
   2. Inlet and outlet of each thermal storage tank.

E. Install liquid-filled-case-type, vapor-actuated dial thermometers at suction and discharge of each pump.

F. Provide the following temperature ranges for thermometers:

   1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
   2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
   3. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

B. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.

C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.

D. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

E. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

F. Install remote-mounting pressure gages on panel.

G. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.

H. Install needle-valve and syphon fitting in piping for each pressure gage for steam.

I. Install test plugs in tees in piping.

J. Install flow indicators, in accessible positions for easy viewing, in piping systems.

K. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

L. Install flowmeter elements in accessible positions in piping systems.

M. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

N. Install wafer-orifice flowmeter elements between pipe flanges.

O. Install permanent indicators on walls or brackets in accessible and readable positions.

P. Install connection fittings for attachment to portable indicators in accessible locations.

Q. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.

R. Assemble components and install thermal-energy meters.

S. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for 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.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 23 05 19

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SECTION 23 05 29 - HANGERS AND SUPPORTS 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for mechanical system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Equipment supports.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 13 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
3. Division 22 Section "Pipe Expansion Fittings and Loops" for pipe guides and anchors.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Globe Pipe Hanger Products, Inc.
3. Grinnell Corp.
4. National Pipe Hanger Corporation.
5. PHD Manufacturing, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Power-Strut Div.; Tyco International, Ltd.
3. Thomas & Betts Corporation.
4. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
1. PHS Industries, Inc.
2. Pipe Shields, Inc.
3. Value Engineered Products, Inc.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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.

1. Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Hilti, Inc.
c. ITW Ramset/Red Head.
d. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified 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. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 6, if little or no insulation is required.
3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
4. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
6. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
7. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
8. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 6.
9. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
10. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 8, from single rod if horizontal movement caused by expansion and contraction might occur.
11. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 8, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
12. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 8, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
13. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 8, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

F. 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 8.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 8, if longer ends are required for riser clamps.

G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

H. 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.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

I. 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.

J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.

b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel 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 building structure.

B. 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 above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

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. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

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. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and

larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so 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 so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

K. Insulated Piping: Comply with the following:

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 according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.
   b. NPS 4 : 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6 : 18 inches long and 0.06 inch thick.

5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 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 smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

3.5 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.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29

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SECTION 23 05 53 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Pipe markers.
5. Stencils.
6. Valve tags.
7. Valve schedules.
8. Warning tags.

1.3 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. Valve numbering scheme.

D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 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 location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:

a. Name and plan number.
b. Equipment service.
c. Design capacity.
d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: 1/16 inch, unless otherwise indicated.
4. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.3 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Aluminum Stencil Paint: Exterior, gloss, acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
2. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect <Insert other>. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick aluminum.
2. Material: 0.0375-inch- thick stainless steel.
3. Material: 3/32-inch- thick laminated plastic with 2 black surfaces and white inner layer.
4. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook VALVE SCHEDULES

B. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches Fasteners: Brass grommet and wire.
2. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
3. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 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.

3.3 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
2. Heat exchangers, coils, evaporators, and similar equipment.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 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.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Fire department hose valves and hose stations.
    c. Meters, gages, thermometers, and similar units.
    d. Pumps, compressors, condensers, and similar motor-driven units.

C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with equipment markers in the following color codes:

    a. Green: For cooling equipment and components.
    b. Yellow: For heating equipment and components.
    c. Orange: For combination cooling and heating equipment and components.

2. Letter Size: Minimum 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.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. Include signs for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Pumps, compressors, condensers, and similar motor-driven units.

E. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

F. Install access panel markers with screws on equipment access panels.

3.4 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.

2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers 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 markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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 markers.

D. Pipe Label Color Schedule:

1. Heating Water Piping: White letters on a safety-green background
2. Refrigerant Piping: Black letters on a safety-white background

3.5 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue For cold-air supply ducts.
2. Yellow For hot-air supply ducts.
3. Green For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches, 2 inches, round.
b. Hot Water: 1-1/2 inches, 2 inches, round.
c. Refrigerant: 1-1/2 inches square
d. Fire Protection: 1-1/2 inches, 2 inches, round.
e. Gas: 1-1/2 inches, 2 inches, round.

2. Valve-Tag Color:

a. Cold Water: Green.
b. Fire Protection: Red
c. Gas: Yellow

3. Letter Color:

a. Cold Water: White.
b. Fire Protection: White.
c. Gas: White.

3.7 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.8 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.9 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.10 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END SECTION 23 05 33

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SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
   a. Constant-volume air systems.
   b. Variable-air-volume systems.
   c. Multizone systems.

1.2 DESCRIPTION

A. This Contractor shall be responsible for providing a complete test-adjust-balance (TAB) work of all systems including systems and the equipment and apparatus connected.

B. The schedule for testing and balancing shall be established by the Contractor in coordination with the TAB agency to complete the work prior to project substantial completion. Work is not considered complete until approved, in writing, by signing Engineer or Architect.

C. The items requiring testing, adjusting, and balancing include but are not limited to the following:

1. AIR SYSTEMS:
   a. Air handling and fan coil units
   b. Ductwork systems
   c. Fans
   d. Terminal Unit Equipment
   e. Diffusers, Registers and Grilles
   f. Coils (Air Temperatures)
   g. Project Differential Pressure Requirements
   h. Project Temperature Requirements
   i. Smoke Control Systems
   j. Control dampers

2. HYDRONIC SYSTEMS:
   a. Pumps
   b. Hydronic piping systems
   c. Chillers
   d. Cooling Towers
   e. Boilers
   f. Heat Exchangers
   g. Coils

3. Plumbing Systems
   a. Pressure booster pumps
   b. Hot water recirculation pumps and branch balancing valves
   c. Filtration systems
   d. Any other circulation systems

D. Test and Balance Contractor shall submit to the engineer a T&B Work Plan prior to the commencement of work. The work plan shall be project specific.

E. The accuracy of measurements shall be in accordance with AABC National Standards or NEBB Procedural Standards for TAB Environmental Systems. Adjustment tolerances shall be + or - 5% unless otherwise stated.

F. Air systems shall be balanced to maintain the positive and negative space pressure relationships indicated in the Contract Documents.

G. The TAB Contractor is required to be at the final AHCA inspection or Owner's substantial completion and be prepared to test 10% of the air distribution devices and water distribution devices to prove that his final report and the design professional's review were correct.

H. Upon direction of the Architect, Engineer or the TAB Contractor, the installing Contractor shall provide, at no additional cost to the Owner, any additional work and/or devices necessary to properly balance the system, including fan sheaves, motor sheave, drive belts, balancing damper, calibrated balancing valves, gauge tapings, flow sensors, and thermometer wells. He shall also be responsible for trimming and balancing constant speed pump impellers as determined by TAB to maximize pump efficiency.

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 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 15days 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.

G. REPORTS
1. Submit six certified bound copies of the final reports on applicable AABC or NEBB Reporting Forms for review and approval by the Engineer. Provide one copy at the site prior to request for final inspection.
2. All outlets, devices, HVAC equipment, etc., shall be identified, along with a numbering system corresponding to report unit identification.
3. A completed and approved certified copy of the test and balance report shall be available at the project site at the 100% AHCA inspection.

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 Construction Manager 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 Owner and 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.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 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 and water distribution systems have been satisfactorily completed.

C. Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the appropriate responsible Contractor or person.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 COORDINATION AND SCHEDULING

A. The schedule for testing and balancing shall be established by the Contractor in coordination with the balancing agency to complete the work prior to project substantial completion.

B. It will be necessary for the balancing agency to perform its services in close coordination with the Contractor and Mechanical Subcontractor.

C. The Contractor shall furnish to the TAB agency a complete set of plans, specifications, approved HVAC submittal data and shop drawings, up-to-date revisions, and other data required for planning, preparation, and execution of the TAB work. This information shall be provided to the TAB agency no later than 30 days prior to the start of TAB work.

D. The installing Contractor shall provide a minimum of three weeks written notification to the Architect/Engineer and TAB Contractor that system installations are complete and are ready for testing.

E. System installation and equipment startup shall be complete prior to the TAB agencies being notified by the Contractor to begin the TAB.

F. The Contractor, subcontractors and equipment suppliers shall all cooperate with the TAB agency to provide all necessary data on the design and proper application of the system components. In addition, they shall furnish all labor and materials required to eliminate reported system deficiencies in a timely manner.

G. The building control system shall be complete and operational. The Controls Contractor shall install all necessary computers and computer programs, and make these operation

al. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.

H. All test points, balancing devices, identification tags, etc. shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.

I. Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

J. Corrections of minor deficiencies identified may be made during the tests at the discretion of the TAB Contractor. In such cases the deficiency and resolution will be documented in the final report.

K. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.

3.3 DEFICIENCY RESOLUTION

L. As test progresses and a deficiency is identified, the TAB Contractor shall coordinate with the Contractors to identify the deficiency for a timely resolution of the deficiency.

M. This Contractor shall include in their base bid the initial test and balance, plus returning to the site for two (2) additional visits to retest systems that do not test within specification requirements. Any additional testing requirements will fall under requirements listed under Cost of Retesting.

N. Cost of Retesting

1. The cost for any additional testing beyond requirement in Paragraph B shall be borne by the installing Contractors, if they are responsible for the deficiency. If they are not responsible, any cost for retesting shall be negotiated with the Contractor.

2. The time for the Architect/Engineer to direct any retesting required because a specific system reported to have been successfully completed, but determined during testing to be faulty, will be back-charged to the Contractor, who may choose to recover costs from the party responsible for stating system was complete.

O. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance, then all identical units may be considered unacceptable by the TAB agent or the Engineer. In such case, the Contractor shall provide the Owner with the following:

1. Within one week of notification from the TAB agent, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Architect/Engineer within two weeks of the original notice.

2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures,

etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The Architect/Engineer will determine whether a replacement of all identical units or a repair is acceptable.

4. Two examples of the proposed solution will be installed by the Contractor then test the installations for up to one week, upon which the Architect/Engineer will decide whether to accept the solution.

5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

3.4 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.5 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.7 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure 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 Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 15 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

P. General Building/Zone Pressurization:

1. The TAB agency shall test and adjust building/zone pressurization by setting the design flows to meet the required flow direction and pressure differential. For positive pressure areas, set the supply air to design flow, and gradually reduce as required the return/exhaust air rate to obtain the required flow or pressure difference. For negative pressure areas, set the supply air to design flow, and grad

ually increase as required the return/exhaust air rate to obtain the required flow or pressure difference.

2. Provide in the TAB report building/zone pressurization indicating the differential pressures of required positive areas, negative areas, and project common spaces to the exterior.

Q. Pressure Sensitive Spaces

1. Coordinate TAB activities with BAS Contractor for pressure-sensitive spaces such as isolation rooms, laboratory spaces, clean rooms, operating rooms, procedure rooms, etc.

2. Pressure sensitive rooms with relative pressure monitors should be balances so they are 0.05” positive or negative to adjacent spaces. Assist contractors with setting up and alarming the wall mounted pressure monitor. The low level alarm should be set at 0.01”.

3. Laboratory spaces to be balanced based upon relative pressures between adjacent spaces. Adjust airflows up or down (from design values) to meet relative pressure requirements.

4. If relative pressures cannot be achieved, then inspect wall and ceiling sealing for visible cracks and air leaks. Advise General Contractor to seal noticeable cracks. If pressures cannot be achieved after wall/ceiling remediation, then advise engineer of the intended actions to increase supply/exhaust airflows as necessary to achieve target relative space pressures.

5. For systems with Phoenix air valves, adjust airflows on air valves as necessary to achieve a minimum of 0.01” relative pressure from room to room.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

E. 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.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.

7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

A. Position the unit's automatic zone dampers for maximum flow through the cooling coil.

B. The procedures for multizone systems will utilize the zone balancing dampers to achieve the indicated airflow within the zone.

C. After balancing, place the unit's automatic zone dampers for maximum heating flow. Retest zone airflows and record any variances.

D. 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 Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

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.

1. 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.
1. Obtain approval from Construction Manager 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.
2. 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 match 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.

5.2 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.

5.3 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

5.4 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

5.5 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.

8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

5.6 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 5 percent.
3. Heating-Water Flow Rate: Plus or minus 5 percent.
4. Cooling-Water Flow Rate: Plus or minus 5 percent.

5.7 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.

5.8 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft. .
h. Tube size in NPS .
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm .
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm .
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F .
k. Leaving-water temperature in deg F.

l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm .
b. Entering-air temperature in deg F .
c. Leaving-air temperature in deg F
d. Air temperature differential in deg F
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h .
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h .
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Air flow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Air flow rate in cfm .
c. Air velocity in fpm.
d. Entering-air temperature in deg F (deg C).
e. Leaving-air temperature in deg F (deg C).
f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.

c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Indicated air flow rate in cfm (L/s).
h. Indicated velocity in fpm (m/s).
i. Actual air flow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.

h. Size.
i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary air flow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final air flow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg F (deg C).

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Entering-water temperature in deg F (deg C).
c. Leaving-water temperature in deg F (deg C).
d. Water pressure drop in feet of head or psig (kPa).
e. Entering-air temperature in deg F (deg C).
f. Leaving-air temperature in deg F (deg C).

L. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

5.9 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 10 percent of terminals.

c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Engineer.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Construction Manager
3. Construction Manager 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.

5.10 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 23 05 93

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SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:

1. Insulation Materials:

    a. Calcium silicate.
    b. Cellular glass.
    c. Flexible elastomeric.
    d. Mineral fiber.
    e. Phenolic foam.
    f. Polyisocyanurate.
    g. Polystyrene.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. Corner angles.

B. Related Sections include the following:

1. Division 2 Section "Hydronic Distribution" for loose-fill pipe insulation in underground piping outside the building.
2. Division 23 Section "Metal Ducts" for duct liners.

1.3 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. FSP: Foil, scrim, polyethylene.

D. PVDC: Polyvinylidene chloride.

E. SSL: Self-sealing lap.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Attachment and covering of heat tracing inside insulation.
3. Insulation application at pipe expansion joints for each type of insulation.
4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Removable insulation at piping specialties, equipment connections, and access panels.
6. Application of field-applied jackets.
7. Application at linkages of control devices.
8. Field application for each equipment type.

C. Installer Certificates: Signed by Contractor certifying that installers comply with requirements.

D. 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.

E. Field quality-control inspection 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting 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 size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork 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.

1.8 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 MANUFACTURERS

A. Use products manufactured by Owens-Corning, Johns Manville, Knauf, Dow Chemical, Kingspan or Certainteed except where the product of another manufacturer is specifically identified for a special type of insulation.

B. The listing of a manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein.

2.2 INSULATION MATERIALS

A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:

1. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Block Insulation: ASTM C 552, Type I.
2. Special-Shaped Insulation: ASTM C 552, Type III.
3. Board Insulation: ASTM C 552, Type IV.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

I. 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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; All-Service Duct Wrap.

J. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Products:

a. Johns Manville; HTB 23 Spin-Glas.
b. Owens Corning; High Temperature Flexible Batt Insulations.

K. 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 and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with

factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

    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.

L. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Available Products:

    a. Fibrex Insulations Inc.; FBX.
    b. Johns Manville; 1000 Series Spin-Glas.
    c. Owens Corning; High Temperature Industrial Board Insulations.
    d. Rock Wool Manufacturing Company; Delta Board.
    e. Roxul Inc.; Roxul RW.
    f. Thermafiber; Thermafiber Industrial Felt.

M. Mineral-Fiber, Preformed Pipe Insulation:

1. Products:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000(Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) 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 Part 2 "Factory-Applied Jackets" Article.
3. Type II, 1200 deg F (649 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

N. 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:

    a. Knauf Insulation; Permawick Pipe Insulation.
    b. Owens Corning; VaporWick Pipe Insulation.

O. 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. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

    a. CertainTeed Corp.; CrimpWrap.
    b. Johns Manville; MicroFlex.
    c. Knauf Insulation; Pipe and Tank Insulation.
    d. Manson Insulation Inc.; AK Flex.
    e. Owens Corning; Fiberglas Pipe and Tank Insulation.

P. Phenolic Foam:

1. Products:

    a. Kingspan Corp.; Koolphen K.

2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in Part 2 "Factory-Applied Jackets" Article.

    a. Preformed Pipe Insulation: ASJ.
    b. Board for Duct and Plenum Applications: ASJ.
    c. Board for Equipment Applications: ASJ.

Q. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

1. Products:

    a. Apache Products Company; ISO-25.
    b. Dow Chemical Company (The); Trymer.
    c. Duna USA Inc.; Corafoam.
    d. Elliott Company; Elfoam.

2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in Part 2 "Factory-Applied Jackets" Article.

    a. Pipe Applications: ASJ-SSL.
    b. Equipment Applications: ASJ-SSL.

R. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products:

a. Armacell LLC; Tubolit.
b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
c. RBX Corporation; Therma-cell.

S. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products:

a. Dow Chemical Company (The); Styrofoam.
b. Knauf Insulation; Knauf Polystyrene.

2.3 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. UL tested and certified to provide a 1 or 2-hour fire rating, as required.

1. Products:

a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 1 or 2-hour fire rating, as required.

1. Products:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.
g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.

2.4 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products:

   a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products:

   a. Insulco, Division of MFS, Inc.; SmoothKote.
   b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
   c. Rock Wool Manufacturing Company; Delta One Shot.

2.5 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).

1. Products:

   a. Childers Products, Division of ITW; CP-97.
   b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
   c. Marathon Industries, Inc.; 290.
   d. Mon-Eco Industries, Inc.; 22-30.
   e. Vimasco Corporation; 760.

C. Cellular-Glass, Phenolic-Foam, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. Products:

   a. Childers Products, Division of ITW; CP-96.
   b. Foster Products Corporation, H. B. Fuller Company; 81-33.

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products:

   a. Aeroflex USA Inc.; Aeroseal.
   b. Armacell LCC; 520 Adhesive.
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.
   d. RBX Corporation; Rubatex Contact Adhesive.

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products:

   a. Childers Products, Division of ITW; CP-82.
   b. Foster Products Corporation, H. B. Fuller Company; 85-20.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.

d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

F. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).

1. Products:

a. Childers Products, Division of ITW; CP-96.
b. Foster Products Corporation, H. B. Fuller Company; 97-13.

G. 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:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

H. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Red Devil, Inc.; Celulon Ultra Clear.
e. Speedline Corporation; Speedline Vinyl Adhesive.

2.6 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products:

a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products:

a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products:

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.7 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products:

a. Childers Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).
4. Color: White.

2.8 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic-Foam, and Polyisocyanurate Products:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.

2. Joint Sealants for Polystyrene Products:

a. Childers Products, Division of ITW; CP-70.
b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
6. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

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 (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products:

    a. Childers Products, Division of ITW; 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 (Minus 40 to plus 121 deg C).
5. Color: White.

2.9 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.
5. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
6. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

    a. Products:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

8. Vinyl Jacket: UL-rated white vinyl with a permeance of 1.3 perms (0.86 metric perms) when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

1. Products:

    a. Vimasco Corporation; Elastafab 894.

B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. inch (2 strands by 2 strands/sq. mm) for covering equipment.

1. Products:

a. Childers Products, Division of ITW; Chil-Glas No. 5.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm), in a Leno weave, for duct, equipment, and pipe.

1. Products:

a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.11 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).

1. Products:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.12 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:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system.
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.

5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
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. Sheet and roll stock ready for shop or field sizing
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) 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.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Sheet and roll stock ready for shop or field sizing.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) 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.

E. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products:

    a. Pittsburgh Corning Corporation; Pittwrap.
    b. Polyguard; Insulrap No Torch 125.

F. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

1. Products:

    a. Polyguard; Alumaguard 60.

G. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

1. Products:

    a. Dow Chemical Company (The), Saran 540 Vapor Retarder Film.

H. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

1. Products:

    a. Dow Chemical Company (The), Saran 560 Vapor Retarder Film.

I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.13 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Products:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    b. Compac Corp.; 104 and 105.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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 and UL listed.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) 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:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products:

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches (75 mm).

3. Film Thickness: 4 mils (0.10 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products:

a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.

2. Width: 3 inches (75 mm).
3. Film Thickness: 6 mils (0.15 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.14 SECUREMENTS

A. Bands:

1. Products:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

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.

a. Products:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

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.

a. Products:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

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. Comply with the following requirements:

a. Products:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
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: Aluminum, 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.

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. Comply with the following requirements:

a. Products:

1) GEMCO; Nylon Hangers.
2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
c. 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).
d. Adhesive: Recommended by hanger manufacturer. 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. Comply with the following requirements:

a. Products:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Aluminum, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. 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, aluminum 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. Products:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. 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.

a. Manufacturers:

1) GEMCO.
2) Midwest Fasteners, Inc.

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:

a. ACS Industries, Inc.
b. C & F Wire.
c. Childers Products.
d. PABCO Metals Corporation.
e. RPR Products, Inc.

2.15 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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.
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 (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range 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 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 trade 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 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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- (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). 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 (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and 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 (100 mm) 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 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.

3. Seal penetrations through fire-rated assemblies according to Division 7 Section "Through-Penetration Firestop Systems."

3.5 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: 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.

3.6 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to 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 overcompress 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. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. 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 latching mechanism.
2. Fabricate boxes from aluminum, at least 0.050 inch (1.3 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.

3.7 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, vessels, and equipment. 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 (50 mm) 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.

3.8 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Boiler Breechings and Ducts:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation material.
2. Install 2-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.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install 2-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. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.9 CELLULAR-GLASS INSULATION INSTALLATION

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 (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but 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 (25 mm), 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.

3.10 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 MINERAL-FIBER INSULATION INSTALLATION

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 (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 (25 mm), 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.

E. Blanket Insulation Installation on Ducts and Plenums: 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 and plenums 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 1 edge and 1 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.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

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.

F. Board Insulation Installation on Ducts and Plenums: 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), space 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. 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 and plenums 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 1 edge and 1 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.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. 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.

3.12 PHENOLIC INSULATION INSTALLATION

A. Common Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

B. 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 (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
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.

3.13 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of polyisocyanurate 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.

3.14 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene 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.

3.15 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 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (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.

D. 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.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. 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. The 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.
5. 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.

3.16 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous UL-listed fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.17 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.

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.

3.18 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent inspecting agency to perform field inspections and prepare inspection reports.

B. Perform the following field tests and inspections and prepare test reports:

1. Inspect ductwork, 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 one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, 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 one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. 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. Remove defective Work.

D. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

3.19 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.
4. Indoor, exposed return located in nonconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.20 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply, return, & outside-air duct insulation shall be any of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

B. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

C. Concealed, supply, return, & outside-air plenum insulation shall be any of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

D. Exposed, supply, return & outside-air duct insulation shall be the following:

1. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m) nominal density.

E. Exposed, exhaust-air duct insulation shall be any of the following:
1. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

F. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated board; thickness as required to achieve 2-hour fire rating.

G. Exposed, supply and return-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

3.21 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Supply, Return and Outside-air duct insulation shall be the following:
1. Mineral-Fiber Board: 3 inches (75 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density finish with aluminum jacket.

3.22 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
1. Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density.
2. Polyolefin: 1 inch thick.

D. Domestic hot-water storage tank insulation shall be either of the following:

1. Mineral-Fiber Board: 4 inches (100 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.
2. Mineral-Fiber Pipe and Tank: 4 inches (100 mm) thick.

E. Breechings
1. Mineral-Fiber Board: 3-1/2 inches thick and 6-lb/cu. ft. nominal density.
2. Provide exterior jacketing on exposed and exterior breeching

F. Engine-Generator Set Exhaust Pipe
1. Mineral-Fiber Board: 3-1/2 inches thick and 6-lb/cu. ft. nominal density.

G. Engine-Generator Set Muffler
1. Mineral-Fiber Board: 3-1/2 inches thick and 6-lb/cu. ft. nominal density.

3.23 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. Fire-suppression piping.
2. Drainage piping located in crawl spaces.
3. Below-grade piping.
4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.24 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be any of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be any of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.
b. Flexible Elastomeric: 1 inch (25 mm) thick.
c. Mineral-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

B. Stormwater and Overflow, Horizontal Piping and adjacent elbow fittings:

1. All Pipe Sizes: Insulation shall be any of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

C. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be any of the following:
a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick blanket wrap.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be any of the following:

a. Flexible Elastomeric: 1/2 inch thick.
b. Mineral-Fiber Pipe Insulation, Type I: 1/2 inch thick.

E. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C), Horizontal piping and adjacent elbow fittings , not required in garage exposed areas.

1. All Pipe Sizes: Insulation shall be any of the following:

a. Flexible Elastomeric: 3/4 inch (19 mm) thick.

F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be any of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.
b. Flexible Elastomeric: 1 inch (25 mm) thick.
c. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

G. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be any of the following:
a. Flexible Elastomeric: 1 inch (25 mm) thick.
b. Mineral-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

H. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be either of the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.

I. Hot Service Drains:

1. Cellular Glass: 1-1/2 inches thick.
2. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

J. Hot Service Vents:

1. Cellular Glass: 1-1/2 inches thick.
2. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick

3.25 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be any of the following:
a. Flexible Elastomeric: 2 inches (50 mm) thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be either of the following:

a. Flexible Elastomeric: 2 inches (50 mm) thick.

3.26 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Loose-fill insulation, for belowground piping, is specified in Division 2 piping distribution Sections.

B. Chilled Water, All Sizes: Cellular glass, 3 inches thick.

C. Condenser-Water Supply and Return, All Sizes: Cellular glass, 2 inches (50 mm) thick.

3.27 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. Ducts and Plenums, Concealed:

1. None.

D. Ducts and Plenums, Exposed:
1. Aluminum, Smooth 0.024 inch (0.61 mm) thick.

E. Equipment, Concealed:

1. None.

F. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. Aluminum, Smooth: 0.024 inch (0.61 mm) thick.

G. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
1. Painted, Aluminum, Smooth and Stucco Embossed with 1-1/4-Inch- (32-mm-) Deep Corrugations: 0.032 inch (0.81 mm), 0.040 inch (1.0 mm) thick.

H. Piping, Concealed:

1. None.

I. Piping, Exposed:

1. PVC 20 mils (0.5 mm) thick.
2. Aluminum, Smooth 0.024 inch (0.61 mm) thick.
3. Painted Aluminum, Smooth 0.024 inch (0.61 mm) thick.

3.28 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. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Exposed:

1. Aluminum, Smooth: 0.024 inch (0.61 mm) thick.

D. Equipment, Concealed:

1. None.

E. Equipment, Exposed:

1. Painted, Aluminum, Smooth: 0.024 inch (0.61 mm) thick.

F. Piping, Concealed:

1. None.

G. Piping, Exposed:
1. Painted ,Aluminum, Smooth: 0.024 inch (0.61 mm) thick.

3.29 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 23 07 00

SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes commissioning process requirements for the following HVAC&R systems, assemblies, and equipment:

1. Energy supply systems, including gas supply.
2. Heat generation systems, including hot-water boilers.
3. Cooling generation systems, including direct-expansion systems.
4. Distribution systems, including air distribution (heating and cooling) systems, hot-water distribution systems, exhaust systems, and air-handling units.
5. Controls and instrumentation, including BAS.
6. Systems testing and balancing verification, including heating-water piping systems, domestic hot-water circulating systems, supply-air systems, return-air systems, and exhaust-air systems.

1.2 DEFINITIONS

A. BAS: Building automation system.

B. DDC: Direct digital controls.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. "Systems," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

E. TAB: Testing, adjusting, and balancing.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For BAS and HVAC&R Testing Technician.

B. Construction Checklists: For the following:

1. Vibration and seismic controls for HVAC&R piping and equipment.
2. Instrumentation and control for HVAC&R.
3. Heating-water piping and accessories.
4. Refrigerant piping.
5. Metal ducts and accessories.
6. Fans.
7. Particulate air filtration.
8. Air-handling units.
9. Boilers.
10. Pumps.

1.4 QUALITY ASSURANCE

A. BAS Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:

1. Journey-level or equivalent skill level with knowledge of BAS, HVAC&R, electrical concepts, and building operations.
2. Minimum five years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
3. International Society of Automation (ISA) Certified Control Systems Technician (CCST) Level I.

B. HVAC&R Testing Technician Qualifications: Technicians to perform HVAC&R construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests and commissioning test demonstrations shall have the following minimum qualifications:

1. Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associates degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC&R systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC&R equipment, assemblies, and systems.
2. Minimum five years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
3. One of the following:

    a. National Environmental Balancing Bureau (NEBB) Certified Testing, Adjusting, and Balancing Technician.
    b. Associated Air Balance Council (AABC) Certified Test and Balance Technician.
    c. Owner retains the right to waive NEBB or AABC Certification.

C. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform HVAC&R commissioning work, perform the following:

1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:

    a. Equipment/instrument identification number.
    b. Planned commissioning application or use.
    c. Manufacturer, make, model, and serial number.
    d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

2. Test equipment and instrumentation shall meet the following criteria:

    a. Capable of testing and measuring performance within the specified acceptance criteria.
    b. Be calibrated at the manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
    c. Be maintained in good repair and operating condition throughout the duration of use on this Project.
    d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

D. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the commissioning process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:

a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:

1) Instrument or tool identification number.
2) Equipment schedule designation of equipment for which the instrument or tool is required.
3) Manufacturer, make, model, and serial number.
4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

b. Include a separate list of proprietary test instrumentation and tools in the operation and maintenance manuals.
c. HVAC&R proprietary test instrumentation and tools become the property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents and approved Shop Drawings and submittals.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Construction Checklists: Prepare and submit detailed construction checklists for HVAC&R systems, subsystems, equipment, and components.

1. Contributors to the development of construction checklists shall include, but are not limited to, the following:

a. HVAC&R systems and equipment installers.
b. TAB technicians.

c. HVAC&R instrumentation and controls installers.

F. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Coordinator and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.
3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

G. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

H. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

I. Coordinate schedule with, and perform the following activities at the direction of, Commissioning Coordinator.

J. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying HVAC systems and equipment.

K. Provide technicians, instrumentation, tools, and equipment to complete and document the following:

1. Performance tests.
2. Demonstration of a sample of performance tests.
3. Commissioning tests.
4. Commissioning test demonstrations.

3.2 TAB COMMISSIONING TESTS

A. TAB Verification:

1. Conditions of the Test:

a. Commissioning Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
b. Systems operating in full heating mode with minimum outside-air volume.
c. Systems operating in full cooling mode with minimum outside-air volume.
d. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.

2. Acceptance Criteria:

a. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

b. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than two times the tolerances allowed.
c. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

3.3 HEATING CONTROL SYSTEM COMMISSIONING TESTS

A. Heating-Water Supply Temperature Control:

1. Prerequisites: Installation verification of the following:

a. Startup of boiler.
b. Startup of heating-water pump(s).
c. TAB of heating-water flow and pressure.
d. Input Device: Heating-water supply temperature; thermistor temperature sensor.
e. Output Device: Control valve.
f. Display the following at the operator's workstation:

1) Heating-water supply temperature.
2) Heating-water supply temperature set point.
3) Control-valve position.

2. Conditions of the Test:

a. Minimum heating-water flow.
b. Midrange Heating-Water Flow: 50 to 60 percent of maximum.
c. Maximum heating-water flow.

3. Acceptance Criteria: Under all conditions, heating-water supply temperature is within plus or minus 2.0 deg F (1.1 deg C) of set point.

B. Heating-Water Supply Temperature Reset:

1. Prerequisites: Installation verification of the following:

a. Startup of boiler.
b. Startup of heating-water pump(s).
c. TAB of heating-water flow and pressure.
d. Input Device: Heating-water supply temperature; thermistor temperature sensor.
e. Input Device: Outdoor-air temperature; outdoor-air sensor.
f. Output Device: Control valve.
g. Display the following at the operator's workstation:

1) Outdoor-air temperature.
2) Heating-water supply temperature.
3) Heating-water supply temperature set point.
4) Control-valve position.

2. Conditions of the Test: Outdoor-air temperature input value may be overridden for this test.

a. Low Temperature: Outdoor-air temperature between 10°F and below.
b. High Temperature: Outdoor-air temperature between 60°F and above.

3. Acceptance Criteria: Heating-water supply temperature resets in straight-line relationship with outdoor-air temperature for the following reset schedule. Under all conditions, heating-water supply temperature is within 2.0 deg F (1.1 deg C) of set point.

    a. 180 deg F (90 deg C) heating water when outdoor-air temperature is 10°F or less.
    b. 140 deg F (54 deg C) heating water when outdoor-air temperature is 60 deg F (18 deg C).
    c. Under all conditions, heating-water supply temperature is within plus or minus 2.0 deg F (1.1 deg C) of set point.

C. Control Primary Circulating Pump(s):

1. Prerequisites: Installation verification of the following:

    a. Startup of heating-water pump(s).
    b. Input Device: Outdoor-air temperature; outdoor-air sensor.
    c. Output Device: Heating-water pump; DDC system command to starter relay.
    d. Display the following at the operator's workstation:

        1) Outdoor-air temperature.
        2) Operating status of primary circulating pump(s).

2. Conditions of the Test:

    a. High Temperature: Outdoor-air temperature above 60 deg F (18 deg C).
    b. Low Temperature: Outdoor-air temperature below 60 deg F (18 deg C).

3. Acceptance Criteria:

    a. Pumps are energized at all times to maintain constant system pressure.

3.4 DUCT HEATING COILS AND UNIT HEATERS COMMISSIONING TESTS

A. Duct Heating Coils:

1. Prerequisites: Installation verification of the following:

    a. Occupancy Input Device: Occupancy sensor.
    b. Occupancy Output Device: DDC system binary output.
    c. Room Temperature Input Device: Electronic temperature sensor.
    d. Room Temperature Output Device: Electronic control-valve operators.
    e. Display the following at the operator's workstation:

        1) Room/area served.
        2) Room occupied/unoccupied.
        3) Room temperature indication.
        4) Room temperature set point.
        5) Room temperature set point, occupied.
        6) Room temperature set point, unoccupied.
        7) Control-valve position as percentage open.

2. Conditions of the Test:

a. Commissioning Test Demonstration Sampling Rate: 10 percent of each model/size unit.
b. Temperature Control - Occupied: Start with the room unoccupied. Occupy the room and observe the change to occupied status. Observe temperature control until room temperature is stable at occupied set point plus or minus 1.0 deg F (0.6 deg C).
c. Temperature Control - Unoccupied: Start with the room occupied. Vacate the room and observe the change to unoccupied status. Observe temperature control until room temperature is stable at unoccupied set point plus or minus 1.0 deg F (0.6 deg C).

3. Acceptance Criteria:

a. Temperature Control - Occupied:

1) Control system status changes from "occupied" to "unoccupied" after the specified time.
2) Room temperature is stable at occupied set point plus or minus 1.0 deg F (0.6 deg C) within 10 minutes of occupancy. Room temperature does not overshoot or undershoot set point by more than 2.0 deg F (1.1 deg C) during transition.

b. Temperature Control - Unoccupied:

1) Control system status changes from "unoccupied" to "occupied" immediately.
2) Room temperature is stable at unoccupied set point plus or minus 1.0 deg F (0.6 deg C) within 30 minutes of occupancy.

3.5 AIR-HANDLING SYSTEM COMMISSIONING TESTS

A. Air-Handler Mixed-Air Control:

1. Prerequisites: Installation verification of the following:

a. Minimum Position Input Device: DDC system time schedule.
b. Output Device: DDC system analog output to modulating damper actuator(s).
c. Heating Reset Input Device: DDC system software.
d. Supply-Air Temperature Input Device: Electronic temperature sensor.
e. Cooling Reset Input Device: Outdoor- and return-air, duct-mounted electronic temperature sensors.
f. Display the following at the operator's workstation:

1) Mixed-air-temperature indication.
2) Mixed-air-temperature set point.
3) Mixed-air damper position.

2. Conditions of the Test:

a. Occupied Time Control: Start in unoccupied schedule. Advance to occupied schedule time.
b. Minimum Damper Position Control: Command system to mode in which minimum damper position is required.
c. Heating Reset Control: Create a call for heating.

d. Supply-Air Temperature Control: Override supply-air temperature set point to a value 2.0 deg F (1.1 deg C) above current supply-air temperature.
e. Cooling Reset Control: Override outdoor-air temperature to a value that exceeds return-air temperature.
f. Unoccupied Time Control: Advance to unoccupied schedule time.
g. Control Data Trend Log: Set up a data trend log of the following input device values and output device commands. Record data at 10 minute intervals. Submit trend data for 7 day periods in which natural conditions require heating reset control, supply-air temperature control, and cooling reset control.

1) Minimum position input device.
2) Heating reset input device.
3) Supply-air temperature input device.
4) Cooling reset input device.

3. Acceptance Criteria:

a. Occupied Time Control: Mixed-air control is active in occupied mode.
b. Minimum Damper Position Control: Controller positions outdoor-air dampers to minimum position.
c. Heating Reset Control: Controller sets outdoor-air dampers to minimum position.
d. Supply-Air Temperature Control: Controller modulates outdoor-, return-, and relief-air dampers to maintain temporary supply-air temperature set point plus or minus 1.0 deg F (0.6 deg C).
e. Cooling Reset Control: Controller sets outdoor-air dampers to minimum position when outdoor-air temperature exceeds return-air temperature.
f. Unoccupied Time Control: Controller positions outdoor- and relief-air dampers closed and return-air dampers open.
g. Control Data Trend Log: Data verifies control according to sequence of control.

END OF SECTION 23 08 00

SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.3 DESCRIPTION OF SYSTEM

A. Furnish and install a complete Building Automation System, BAS, utilizing Direct Digital Controls, DDC, in accordance with drawings, specifications and intent of the design.

B. The BAS shall comply with the latest ANSI/ASHRAE Standard 135, BACnet. This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc. and all air handlers, boilers, chillers, and any other listed equipment using native BACnet-compliant components

C. All components not specifically indicated or specified, but necessary to make the system function within the intent of the specification, are to be included

D. Size all control apparatus to properly supply and/or operate and control the apparatus served.

E. All electrical products shall be listed and labeled by UL and comply with NEMA Standards.

F. All electrical work required as an integral part of the Building Automation System is the responsibility of the control contractor, including but limited to motor starters, control wiring, interlock wiring, electrical wiring, and associated control power wiring. All control wiring and conduit shall comply with NEC and Division 16 of Specifications.

G. All control wiring shall be installed in conduit.

H. Provide telephone modem and phone line for remote communication to the BAS system.

1.4 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. MS/TP: Master slave/token passing.

D. PC: Personal computer.

E. PID: Proportional plus integral plus derivative.

F. RTD: Resistance temperature detector.

1.5 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
b. Water Flow: Plus or minus 5 percent of full scale.
c. Water Pressure: Plus or minus 2 percent of full scale.
d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
i. Relative Humidity: Plus or minus 5 percent.
j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
l. Airflow (Terminal): Plus or minus 10 percent of full scale.
m. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
n. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
o. Carbon Monoxide: Plus or minus 5 percent of reading.
p. Carbon Dioxide: Plus or minus 50 ppm.
q. Electrical: Plus or minus 5 percent of reading.

1.6 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.

2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.

D. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks.

E. Samples for Initial Selection: For each color required, of each type of thermostat[or sensor] cover with factory-applied color finishes.

F. Samples for Verification: For each color required, of each type of thermostat[or sensor] cover.

G. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

5. Software license required by and installed for DDC workstations and control systems.

H. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

I. Field quality-control test reports.

J. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE 135 for DDC system components.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.9 GUARANTEE/MAINTENANCE

A. Guarantee the Building Automations to maintain the temperature in rooms within one degree of the setting and further guarantee all work, materials equipment, and controls against defects in workmanship and material and provide service for a period of one (1) year from date of final acceptance.

B. Replace any defective workmanship or material developing within that time as soon as possible at no charge to the Owner.

C. After completion of the installation, the Building Automation System manufacturer shall regulate and adjust all thermostats, control valves, control motors, and other equipment provided in this contract.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.11 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

C. Coordinate equipment with Division 16 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

D. Coordinate equipment with Division 16 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

E. Coordinate equipment with Division 16 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

F. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers specified.

2.2 CONTROL SYSTEM

A. Manufacturers:

1. Andover Controls Corporation.
2. Automated Logic Corporation.
3. Delta Controls Inc.
4. Honeywell International Inc.; Home & Building Control.
5. Invensys Building Systems.
6. Johnson Controls, Inc.; Controls Group.
7. McQuay International.
8. Siemens Building Technologies, Inc.

9. Tour & Andersson Control, Inc.
10. Trane; Worldwide Applied Systems Group

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

D. Control system shall include the following:

1. Building intrusion detection system specified in Division 28 Section "Intrusion Detection."
2. Building clock control system specified in Division 27 Section "Clock Systems."
3. Building lighting control system specified in Division 26 Section "Network Lighting Controls."
4. Fire alarm system specified in Division 28 Section "Fire Detection and Alarm."

2.3 WEB ACCESS

A. DDC system shall be Web-Based.

1. Web-Based Access to DDC System:

a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet.
b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
c. Web access shall be password protected.

B. DDC System Data Storage:

1. Include server(s) with disk drive data storage to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
2. When logged onto a server, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
3. Server(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.

2.4 DDC EQUIPMENT

A. Operator Workstation: One PC-based microcomputer(s) with minimum configuration as follows:

1. Motherboard: With 8 integrated USB 3.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Dual Intel Pentium 7 minimum 3 MHz.
3. Random-Access Memory: 8 GB.
4. Graphics: Video adapter, minimum 1280 x 1024 pixels, 64 MB video memory, with TV out.
5. Monitor: 19 inches (480 mm) LCD color.
6. Keyboard: QWERTY, 105 keys in ergonomic shape.
7. Hard-Disk Drive: 500 GB
8. Mouse: Three button, optical.
9. Uninterruptible Power Supply: 2 kVa.
10. Operating System: Microsoft Windows 10 with high-speed Internet access.

    a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

11. Application Software:

    a. I/O capability from operator station.
    b. System security for each operator via software password and access levels.
    c. Automatic system diagnostics; monitor system and report failures.
    d. Database creation and support.
    e. Automatic and manual database save and restore.
    f. Dynamic color graphic displays with up to 10 screen displays at once.
    g. Custom graphics generation and graphics library of HVAC equipment and symbols.
    h. Alarm processing, messages, and reactions.
    i. Trend logs retrievable in spreadsheets and database programs.
    j. Alarm and event processing.
    k. Object and property status and control.
    l. Automatic restart of field equipment on restoration of power.
    m. Data collection, reports, and logs. Include standard reports for the following:

        1) Current values of all objects.
        2) Current alarm summary.
        3) Disabled objects.
        4) Alarm lockout objects.
        5) Logs.

    n. Custom report development.
    o. Utility and weather reports.
    p. Workstation application editors for controllers and schedules.
    q. Maintenance management.

12. Custom Application Software:

    a. English language oriented.
    b. Full-screen character editor/programming environment.
    c. Allow development of independently executing program modules with debugging/simulation capability.
    d. Support conditional statements.
    e. Support floating-point arithmetic with mathematic functions.
    f. Contains predefined time variables.

B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.
    d. Software applications, scheduling, and alarm processing.
    e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

    a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
    b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
    c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
    d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    e. Remote communications.
    f. Maintenance management.
    g. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
6. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
5. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
5. Analog Outputs: Provide modulating signal, either low voltage 0- to 10-V dc or current 4 to 20 mA
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

G. Backup Power Source:

1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.

H. UPS:

1. DDC system products powered by UPS units shall include the following:

a. Desktop operator workstations.
b. Printers.
c. Servers.
d. Gateways.
e. DDC controllers

2. DDC system instruments and actuators powered by UPS units shall include all Instruments, Dampers, actuators, Valves and actuators associated with any system serving the Operating Rooms and Recovery Areas.

I. Continuity of Operation after Electric Power Interruption:

1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 64 bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Operator sign-on and sign-off activity shall be recorded and sent to printer.
6. Security Access:

a. Operator access to DDC system shall be under password control.
b. An alphanumeric password shall be field assignable to each operator.
c. Operators shall be able to access DDC system by entry of proper password.
d. Operator password shall be same regardless of which computer or other interface means is used.
e. Additions or changes made to passwords shall be updated automatically.

f. Each operator shall be assigned an access level to restrict access to data and functions the operator is cable of performing.
g. Software shall have at least five access levels.
h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.

7. Data Segregation:

a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.
b. Include at least 32 segregation groups.
c. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.
d. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
e. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.
f. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.

8. Operators shall be able to perform commands including, but not limited to, the following:

a. Start or stop selected equipment.
b. Adjust set points.
c. Add, modify, and delete time programming.
d. Enable and disable process execution.
e. Lock and unlock alarm reporting for each point.
f. Enable and disable totalization for each point.
g. Enable and disable trending for each point.
h. Override control loop set points.
i. Enter temporary override schedules.
j. Define holiday schedules.
k. Change time and date.
l. Enter and modify analog alarm limits.
m. Enter and modify analog warning limits.
n. View limits.
o. Enable and disable demand limiting.
p. Enable and disable duty cycle.
q. Display logic programming for each control sequence.

9. Reporting:

a. Generated automatically and manually.
b. Sent to displays, printers and disk files.
c. Types of Reporting:

1) General listing of points.
2) List points currently in alarm.
3) List of off-line points.
4) List points currently in override status.

5) List of disabled points.
6) List points currently locked out.
7) List of items defined in a "Follow-Up" file.
8) List weekly schedules.
9) List holiday programming.
10) List of limits and deadbands.

10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.

C. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable (for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.
2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.
3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.
4. Descriptors for graphics, points, alarms and such shall be modified through operator's workstation under password control.
5. Graphic displays shall be online user definable and modifiable using the hardware and software provided.
6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.
7. Graphics are to be online programmable and under password control.
8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.
9. Graphics shall also contain software points.
10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.
11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing device. Back trace shall show all previous penetration levels. Include operator with option of showing each graphic full screen size with back trace as horizontal header or by showing a "stack" of graphics, each with a back trace.
12. Display operator accessed data on the monitor.
13. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.
14. Include operator with means to directly access graphics without going through penetration path.
15. Dynamic data shall be assignable to graphics.
16. Display points (physical and software) with dynamic data provided by DDC system with appropriate text descriptors, status or value, and engineering unit.
17. Use color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.
18. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.

a. For an analog command point such as set point, current conditions and limits shall be displayed and operator can position new set point using pointing device.

b. For a digital command point such as valve position, valve shall show its current state such as open or closed and operator could select alternative position using pointing device.
c. Keyboard equivalent shall be available for those operators with that preference.

19. Operator shall be able to split or resize viewing screen into quadrants to show one graphic on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing, curve plot and other information on other quadrants on screen. This feature shall allow real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.
20. Help Features:

a. On-line context-sensitive help utility to facilitate operator training and understanding.
b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.

1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed word-processing program, which shall run concurrently with operating system software.

c. Available for Every Menu Item:

1) Index items for each system menu item.

21. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.

a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, valves pumps, and electrical symbols.
b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:

1) Define background screens.
2) Define connecting lines and curves.
3) Locate, orient and size descriptive text.
4) Define and display colors for all elements.
5) Establish correlation between symbols or text and associated system points or other displays.

D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.
2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:

a. Room layouts with room identification and name.
b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.
c. Location and identification of each hardware point being controlled or monitored by DDC system.

3. Control schematic for each of following, including a graphic system schematic representation similar to that indicated on Drawings, with point identification, set point and dynamic value indication control logic diagram.
4. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.
5. DDC system network riser diagram that shows schematic layout for entire system including all networks and all controllers.

E. Customizing Software:

1. Software to modify and tailor DDC system to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.
2. Online modification of DDC system configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
3. As a minimum, include the following modification capability:

    a. Operator assignment shall include designation of operator passwords, access levels, point segregation and auto sign-off.
    b. Peripheral assignment capability shall include assignment of segregation groups and operators to consoles and printers, designation of backup workstations and printers, designation of workstation header points and enabling and disabling of print-out of operator changes.
    c. System configuration and diagnostic capability shall include communications and peripheral port assignments, DDC controller assignments to network, DDC controller enable and disable, assignment of command trace to points and application programs and initiation of diagnostics.
    d. System text addition and change capability shall include English or native language descriptors for points, segregation groups and access levels and action messages for alarms, run time and trouble condition.
    e. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedules.
    f. Point related change capability shall include the following:

        1) System and point enable and disable.
        2) Run-time enable and disable.
        3) Assignment of points to segregation groups, calibration tables, lockout, and run time and to a fixed I/O value.
        4) Assignment of alarm and warning limits.

    g. Application program change capability shall include the following:

        1) Enable and disable of software programs.
        2) Programming changes.
        3) Assignment of comfort limits, global points, time and event initiators, time and event schedules and enable and disable time and event programs.

4. Software shall allow operator to add points, or groups of points, to DDC system and to link them to energy optimization and management programs. Additions and modifications shall be online programmable using operator workstation, downloaded to other network devices and entered into their databases. After verification of point additions and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.

5. Include high-level language programming software capability for implementation of custom DDC programs. Software shall include a compiler, linker, and up- and down-load capability.
6. Include a library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences. Also include, as a minimum, the following:

    a. Proportional control (P).
    b. Proportional plus integral (PI).
    c. Proportional plus integral plus derivative (PID).
    d. Adaptive and intelligent self-learning control.

        1) Algorithm shall monitor loop response to output corrections and adjust loop response characteristics according to time constant changes imposed.
        2) Algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of system dynamics so that on system shut down and restart, learning process starts from where it left off.

7. Fully implemented intrinsic control operators including sequence, reversing, ratio, time delay, time of day, highest select AO, lowest select AO, analog controlled digital output, analog control AO, and digitally controlled AO.
8. Logic operators such as "And," "Or," "Not," and others that are part of a standard set available with a high-level language.
9. Arithmetic operators such as "Add," "Subtract," "Multiply," "Divide," and others that are part of a standard set available with a high-level language.
10. Relational operators such as "Equal To," "Not Equal To," "Less Than," "Greater Than," and others that are part of a standard set available with a high-level language.

F. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers.
2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
4. Alarms display shall include the following:

    a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
    b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
    c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
    d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
6. Send e-mail alarm messages to designated operators.
7. Send e-mail, page, text and voice messages to designated operators for critical alarms.
8. Alarms shall be categorized and processed by class.

    a. Class 1:

1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.
2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.

b. Class 2:

1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
2) Acknowledgement may be through a multiple alarm acknowledgment.

c. Class 3:

1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.

d. Class 4:

1) Routine maintenance or other types of warning alarms.
2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.

9. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
10. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.

G. Reports and Logs:

1. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
2. Each report shall be definable as to data content, format, interval and date.
3. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on server for historical reporting.
4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
5. Reports and logs shall be stored on server hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

H. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.

2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Logs:

    a. Alarm history.
    b. System messages.
    c. System events.
    d. Trends.

I. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.

J. Tenant Override Reports: Prepare Project-specific reports.

1. Weekly report showing daily total time in hours that each tenant has requested after-hours HVAC.
2. Monthly report showing daily total time in hours that each tenant has requested after-hours HVAC.
3. Annual summary report that shows after-hours HVAC usage on a monthly basis.

K. HVAC Equipment Reports: Prepare Project-specific reports.

1. Chiller Report: Daily report showing operating conditions of each chiller according to ASHRAE 147, including, but not limited to, the following:

    a. Chilled-water entering temperature.
    b. Chilled-water leaving temperature.
    c. Chilled-water flow rate.
    d. Chilled-water inlet and outlet pressures.
    e. Evaporator refrigerant pressure and temperature.
    f. Condenser refrigerant pressure and liquid temperature.
    g. Condenser-water entering temperature.
    h. Condenser-water leaving temperature.
    i. Condenser-water flow rate.
    j. Refrigerant levels.
    k. Oil pressure and temperature.
    l. Oil level.
    m. Compressor refrigerant discharge temperature.
    n. Compressor refrigerant suction temperature.
    o. Addition of refrigerant.
    p. Addition of oil.
    q. Vibration levels or observation that vibration is not excessive.
    r. Motor amperes per phase.
    s. Motor volts per phase.
    t. Refrigerant monitor level (PPM).
    u. Purge exhaust time or discharge count.
    v. Ambient temperature (dry bulb and wet bulb).
    w. Date and time logged.

L. Utility Reports: Prepare Project-specific reports.

1. Electric Report:

a. Include weekly report showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
b. Include monthly report showing the daily electrical consumption and peak electrical demand with time and date stamp for each meter.
c. Include annual report showing the monthly electrical consumption and peak electrical demand with time and date stamp for each meter.
d. For each weekly, monthly and annual report, include sum total of submeters combined by load type, such as lighting, receptacles and HVAC equipment showing daily electrical consumption and peak electrical demand.
e. For each weekly, monthly and annual report, include sum total of all submeters in building showing electrical consumption and peak electrical demand.

2. Natural Gas Report:

a. Include weekly report showing daily natural gas consumption and peak natural gas demand with time and date stamp for each meter.
b. Include monthly report showing the daily natural gas consumption and peak natural gas demand with time and date stamp for each meter.
c. Include annual report showing the monthly natural gas consumption and peak natural gas demand with time and date stamp for each meter.
d. For each weekly, monthly and annual report, include sum total of submeters combined by load type, such as boilers and service water heaters showing daily natural gas consumption and peak natural gas demand.
e. For each weekly, monthly and annual report, include sum total of all submeters in building showing natural gas consumption and peak natural gas demand.

3. Service Water Report:

a. Include weekly report showing daily service water consumption and peak service water demand with time and date stamp for each meter.
b. Include monthly report showing the daily service water consumption and peak service water demand with time and date stamp for each meter.
c. Include annual report showing the monthly service water consumption and peak service water demand with time and date stamp for each meter.
d. For each weekly, monthly and annual report, include sum total of submeters combined by load type, such as cooling tower makeup and irrigation showing daily service water consumption and peak service water demand.
e. For each weekly, monthly and annual report, include sum total of all submeters in building showing service water consumption and peak service water demand.

M. Standard Trends:

1. Trend all I/O point present values, set points, and other parameters indicated for trending.
2. Trends shall be associated into groups, and a trend report shall be set up for each group.
3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75 of DDC controller buffer limit, or by operator request, or by archiving time schedule.
4. Preset trend intervals for each I/O point after review with Owner.
5. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Minimum number of consecutive trend values stored at one time shall be 100 per variable.
6. When drive storage memory is full, most recent data shall overwrite oldest data.
7. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.

N. Custom Trends: Operator shall be able to define a custom trend log for any I/O point in DDC system.

1. Each trend shall include interval, start time, and stop time.
2. Data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on server hard drives.
3. Data shall be retrievable for use in spreadsheets and standard database programs.

O. Programming Software:

1. Include programming software to execute sequences of operation indicated.
2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
3. Programing software shall be one of the following:

    a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for DDC control systems.

        1) Function blocks shall be assembled with interconnection lines that represent to control sequence in a flowchart.
        2) Programming tools shall be viewable in real time to show present values and logical results of each function block.

    b. Menu Based: Programming shall be done by entering parameters, definitions, conditions, requirements and constraints.
    c. Line by Line and Text Based: Programming shall declare variable types such as local, global, real, integer, and so on, at the beginning of the program. Use descriptive comments frequently to describe programming code.

4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

P. Database Management Software:

1. Where a separate SQL database is used for information storage, DDC system shall include database management software that separates database monitoring and managing functions by supporting multiple separate windows.
2. Database secure access shall be accomplished using standard SQL authentication including ability to access data for use outside of DDC system applications.
3. Database management function shall include summarized information on trend, alarm, event, and audit for the following database management actions:

    a. Backup.
    b. Purge.
    c. Restore.

4. Database management software shall support the following:

    a. Statistics: Display database server information and trend, alarm, event, and audit information on database.
    b. Maintenance: Include method of purging records from trend, alarm, event and audit databases by supporting separate screens for creating a backup before purging, selecting database, and allowing for retention of a selected number of day's data.
    c. Backup: Include means to create a database backup file and select a storage location.

d. Restore: Include a restricted means of restoring a database by requiring operator to have proper security level.

5. Database management software shall include information of current database activity, including the following:

a. Ready.
b. Purging record from a database.
c. Action failed.
d. Refreshing statistics.
e. Restoring database.
f. Shrinking a database.
g. Backing up a database.
h. Resetting Internet information services.
i. Starting network device manager.
j. Shutting down the network device manager.
k. Action successful.

6. Database management software monitoring functions shall continuously read database information once operator has logged on.
7. Include operator notification through on-screen pop-up display and e-mail message when database value has exceeded a warning or alarm limit.
8. Monitoring settings window shall have the following sections:

a. Allow operator to set and review scan intervals and start times.
b. E-mail: Allow operator to create and review e-mail and phone text messages to be delivered when a warning or an alarm is generated.
c. Warning: Allow operator to define warning limit parameters, set reminder frequency and link e-mail message.
d. Alarm: Allow operator to define alarm limit parameters, set reminder frequency and link e-mail message.
e. Database Login: Protect system from unauthorized database manipulation by creating a read access and a write access for each of trend, alarm, event and audit databases as well as operator proper security access to restore a database.

9. Monitoring settings taskbar shall include the following informational icons:

a. Normal: Indicates by color and size, or other easily identifiable means that all databases are within their limits.
b. Warning: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their warning limit.
c. Alarm: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their alarm limit.

2.6 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72 hour battery backup.

2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
4. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
5. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
6. Enclosure: Waterproof rated for operation at 40 to 150 deg F (5 to 65 deg C).

2.7 ALARM PANELS

A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch- (1.5-mm-) thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.

B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.

1. Alarm Condition: Indicating light flashes and horn sounds.
2. Acknowledge Switch: Horn is silent and indicating light is steady.
3. Second Alarm: Horn sounds and indicating light is steady.
4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.8 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.

1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig (21 to 90 kPa).
2. Proportional band shall extend from 2 to 20 percent for 5 psig (35 kPa).
3. Authority shall be 20 to 200 percent.
4. Air-supply pressure of 18 psig (124 kPa), input signal of 3 to 15 psig (21 to 103 kPa), and output signal of zero to supply pressure.
5. Gages: [1-1/2 inches (38 mm)] [2-1/2 inches (64 mm)] [3-1/2 inches (89 mm)] in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

2.9 TIME CLOCKS

A. Manufacturers:

1. ATC-Diversified Electronics.
2. Grasslin Controls Corporation.
3. Paragon Electric Co., Inc.
4. Precision Multiple Controls, Inc.
5. SSAC Inc.; ABB USA.
6. TCS/Basys Controls.
7. Theben AG - Lumilite Control Technology, Inc.
8. Time Mark Corporation.

B. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.

C. Solid-state, programmable time control with 4 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.10 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:

a. BEC Controls Corporation.
b. Ebtron, Inc.
c. Heat-Timer Corporation.
d. I.T.M. Instruments Inc.
e. MAMAC Systems, Inc.
f. RDF Corporation.

2. Accuracy: Plus or minus 0.5 deg F (0.3 deg C)at calibration point.
3. Wire: Twisted, shielded-pair cable.

4. Insertion Elements in Ducts: Single point, [8 inches (200 mm)] [18 inches (460 mm)] long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
5. Averaging Elements in Ducts: [36 inches (915 mm) long, flexible] [72 inches (1830 mm) long, flexible] [18 inches (460 mm) long, rigid]; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Concealed
    b. Set-Point Indication: Exposed.
    c. Thermometer: Concealed

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Manufacturers:

    a. BEC Controls Corporation.
    b. MAMAC Systems, Inc.
    c. RDF Corporation.

2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, [8 inches (200 mm)] [18 inches (460 mm)] long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
5. Averaging Elements in Ducts: 18 inches (460 mm) long, rigid use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Concealed
    b. Set-Point Indication: Exposed.
    c. Thermometer: Concealed.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:

    a. BEC Controls Corporation.
    b. General Eastern Instruments.
    c. MAMAC Systems, Inc.
    d. ROTRONIC Instrument Corp.

e. TCS/Basys Controls.
f. Vaisala.

2. Accuracy: [5] [2] percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.

a. Set-Point Adjustment: Concealed
b. Set-Point Indication: Exposed.
c. Thermometer: Concealed

5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F (minus 30 to plus 85 deg C)
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:

a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

G. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Adjusting Key: As required for calibration and cover screws.

2.11 FLOW MEASURING STATIONS

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.

1. Manufacturers:

   a. Air Monitor Corporation.
   b. Wetmaster Co., Ltd.
   c. Trane

2. Casing: Galvanized-steel frame.
3. Flow Straightener: Aluminum honeycomb, 3/4-inch (20-mm) parallel cell, 3 inches (75 mm) deep.
4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

2.12 THERMOSTATS

A. Manufacturers:

1. Erie Controls.
2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
3. Heat-Timer Corporation.
4. Sauter Controls Corporation.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.

B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

   a. Time of day.
   b. Actual room temperature.
   c. Programmed temperature.
   d. Programmed time.
   e. Duration of timed override.
   f. Day of week.
   g. System mode indications include "heating," "off," "fan auto," and "fan on."

   h. Insulating Bases: For thermostats located on exterior walls.
   i. Adjusting Key: As required for calibration and cover screws.
   j. Aspirating Boxes: For flush-mounted aspirating thermostats.
   k. Set-Point Adjustment: 1/2-inch- (13-mm-) diameter, adjustment knob.

C. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

D. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

E. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual or automatic reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

F. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual or automatic reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

G. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig (172 kPa), and cast housing with position indicator and adjusting knob.

2.13 HUMIDISTATS

A. Manufacturers:

1. MAMAC Systems, Inc.
2. ROTRONIC Instrument Corp.

B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.14 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. 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.
3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): 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).
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

5. 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).
6. 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).

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:

a. Belimo Aircontrols (USA), Inc.

2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:
   a. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.

4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24 V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: 40 to 104 deg F (5 to 40 deg C).
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).

2.15 CONTROL VALVES

A. Manufacturers:

1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
2. Erie Controls.
3. Hayward Industrial Products, Inc.
4. Magnatrol Valve Corporation.
5. Neles-Jamesbury.
6. Parker Hannifin Corporation; Skinner Valve Division.
7. Sauter Controls Corporation.

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.

D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

E. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.

2.16 DAMPERS

A. Manufacturers:

1. Air Balance Inc.
2. Don Park Inc.; Autodamp Div.
3. TAMCO (T. A. Morrison & Co. Inc.).
4. United Enertech Corp.
5. Vent Products Company, Inc.

B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).

1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

2.17 SMOKE DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.

b. Greenheck Fan Corporation.

c. Nailor Industries Inc.

d. Ruskin Company.

e. or equal standard products of the BAS manufacturer

2. General Requirements: Label according to UL 555S by an NRTL.

3. Frame: Multiple-blade type; fabricated with roll-formed, 0.062-inch- (1.59-mm-) thick galvanized steel; with mitered and interlocking corners.

4. Blades: Air foil, horizontal, interlocking, 0.078-inch- (2.00-mm-) thick, galvanized sheet steel.

5. Leakage: Class I .

6. Rated pressure and velocity to exceed design airflow conditions.

7. Mounting Sleeve: Factory-installed, 0.062-inch- (1.6-mm-) , or duct thickness whichever is greater, thick, galvanized sheet steel; length to suit wall or floor application.

8. Damper Motors: two-position action.

9. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Mechanical and Electrical Supplemental Requirements"

   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.

   b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections.

   c. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

   d. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).

   e. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).

   f. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).

   g. Electrical Connection: 24 V.

10. Accessories:

    a. Auxiliary switches for position indication.

    b. Momentary test switch, damper mounted.

2.18 COMBINATION FIRE AND SMOKE DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.

   b. Cesco Products; a division of Mestek, Inc.

   c. Greenheck Fan Corporation.

   d. Nailor Industries Inc.

   e. Ruskin Company.

2. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

3. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.

4. Fire Rating: 1-1/2 hours. Coordinate with Life Safety Plan

5. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

6. Frame: Multiple-blade type; fabricated with roll-formed, 0.062-inch- (1.59-mm-) thick galvanized steel; with mitered and interlocking corners.

7. Blades: Roll-formed, horizontal, interlocking, 0.078-inch- (2.0-mm-) thick, galvanized sheet steel.

8. Leakage: Class I.

9. Rated pressure and velocity to exceed design airflow conditions.

10. Mounting Sleeve: Factory-installed, 0.062-inch- (1.6-mm-), or duct thickness whichever is greater, thick, galvanized sheet steel; length to suit wall or floor application.

11. Damper Motors: two-position action.

12. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "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.

    b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections.

    c. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

d. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).

e. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).

f. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).

g. Electrical Connection: 24 V.

13. Accessories:

a. Auxiliary switches for position indication.

b. Momentary test switch, damper mounted.

2.19 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 GENERAL

A. Install all control equipment and wiring in a neat and workmanlike manner to the satisfaction of the Architect and/or Engineer.

B. All immersion wells, pressure tappings and any associated shutoff cocks, flow switches, level switches and other such items furnished by the control manufacturer shall be installed by the mechanical contractor under the coordinating control and supervision of the control contractor.

C. Install all control devices in a location accessible to maintenance personnel. For example: above a lay-in ceiling and not a hard ceiling, actuators facing downward or sideways in congested areas, valves near floor level instead of at high points, etc.

D. Provide, install, calibrate and demonstrate to the owner a complete and functioning control system per the specified sequence of operations and commissioning requirements.

E. All wiring required for a full and functioning control system per the sequence of operations is work of this section.

F. All control panels shall be provided and installed where shown on plans or detailed within the specifications. Control panels provided to locations other than shown shall be provided, installed and powered by the control system manufacturer/installer. The controls contractor is to provide ample power wiring to power all panels from Power Panels as designated.

1. Control panels for the rooftop air handlers shall be located a location approved by the Architect/Engineer.

2. Control panels for the indoor air handlers shall be located within the same room as the air handler.

G. Provide and install all devices, and wiring between HVAC manufacturer's factory installed equipment and all remotely mounted equipment such as flow switches and, data gathering cabinets and miscellaneous equipment for a complete and operating system.

H. All terminations made within the control manufacturer/ installers' panels shall be verified and tested prior to final powering of panel. Control devices from other systems shall not be temporarily or permanently mounted within the control panel.

I. TEST AND BALANCE AND COMMISSIONING

1. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance and commissioning purposes.

2. The Contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.

3. In addition, the Contractor shall provide a qualified technician to assist in the test and balance and commissioning process.

4. The tools used during the test and balance and commissioning process will be returned at the completion of the testing and balancing and commissioning.

J. WORK BY OTHERS

1. All valves and dampers shall be installed by the mechanical contractor. All pipe and duct penetrations shall be provided by the mechanical contractor, or his designated subcontractor.

K. DAMPERS

1. All dampers furnished by the control manufacturer shall be installed by the mechanical contractor under the coordinating control and supervision of the control contractor.

2. Any necessary blank-off plates or transitions required to facilitate the standard size dampers shall be provided by the mechanical contractor. In areas where the damper is 70% or more of the duct area, blank-off plates are to be used. In areas where the damper is less than 70% of the duct area, a transition shall be provided.

L. VALVES

1. All temperature control valves, furnished by the control manufacturers shall be installed by the mechanical contractor under the coordinating control and supervision of the control contractor.

2. Valve submittals shall be coordinated for type, quantity, size and piping configuration to ensure compatibility with pipe design.

3. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.

4. Valves shall be installed in accordance with the manufacturer's recommendations. Installation in a horizontal pipe run is preferred.

5. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.

6. Unions shall be installed at all connections to screw-type control valves.

7. Provide tags for all control valves indicating service and number. Match identification numbers as shown on approved controls shop drawings.

3.2 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.3 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Mount compressor and tank unit on spring isolators with 1-inch (25 mm) static deflection Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's written instructions and seismic-control requirements.

1. Pipe manual and automatic drains to nearest floor drain.
2. Supply instrument air from compressor units through filter, pressure-reducing valve, and pressure relief valve, with pressure gages and shutoff and bypass valves.

D. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

F. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

I. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

J. Install steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."

K. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."

L. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

M. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Pressure test control air piping at 30 psig (207 kPa) or 1.5 times the operating pressure for 24 hours, with maximum 5-psig (35-kPa) loss.
5. Pressure test high-pressure control air piping at 150 psig (1034 kPa) and low-pressure control air piping at 30 psig (207 kPa) for 2 hours, with maximum 1-psig (7-kPa) loss.
6. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
7. Test each point through its full operating range to verify that safety and operating control set points are as required.
8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
9. Test each system for compliance with sequence of operation.
10. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

END OF SECTION 23 09 00

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SECTION 23 11 15 - FUEL GAS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes fuel gas piping within the building. Plumbing Contractor shall include the following:

1. Pipe, tube, fittings, and joining materials.
2. Protective pipe and fitting coating.
3. Piping specialties.
4. Specialty valves.
5. Service meters (by local gas co., located outside of building).
6. Pressure regulators 1st and 2nd stage regulators (by local gas co., located outside of building).
7. 1,000 gallon underground storage tanks.

B. Related Sections include the following:

1. Division 2 Section "Natural Gas Distribution" for natural gas service piping, specialties, and accessories outside the building.

1.3 PROJECT CONDITIONS

A. Gas System Pressure: One pressure range. 0.5 psig or less.

B. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 2504 Btu/cu. ft.
2. Nominal Specific Gravity: 0.6.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Corrugated, stainless-steel tubing systems. Include associated components.
2. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.

B. Shop Drawings: For fuel gas piping. Include plans and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Welding certificates.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For natural gas specialties and accessories to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. NFPA Standard: Comply with NFPA 58, "Liquefied Petroleum Gas Code."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day.

1.7 COORDINATION

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 CORRUGATED, STAINLESS-STEEL TUBING SYSTEMS

A. Description: Comply with AGA LC 1 and include the following:

1. Tubing: Corrugated stainless steel with plastic jacket or coating.
2. Fittings: Copper alloy with ends made to fit corrugated tubing. Include ends with threads according to ASME B1.20.1 if connection to threaded pipe or fittings is required.
3. Striker Plates: Steel, designed to protect tubing from penetrations.
4. Manifolds: Malleable iron or steel with protective coating. Include threaded connections according to ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
5. Manufacturers:

a. OmegaFlex, Inc. (TracPipe)
b. Titeflex Corp. (GasTite)

2.4 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

A. Steel Pipe: ASTM A 53/A 53M; Type E or S; Grade B; black. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
6. Joint Compound and Tape: Suitable for natural gas.
7. Steel Flanges and Flanged Fittings: ASME B16.5.
8. Gasket Material: Thickness, material, and type suitable for natural gas.

B. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), drawn temper.

1. Copper Fittings: ASME B16.22, wrought copper, streamlined pattern.
2. Brazing Filler Metals: AWS A5.8, Silver Classification BAg-1. Filler metal containing phosphorus is prohibited.
3. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
4. Gasket Material: Thickness, material, and type suitable for natural gas.

C. Tin-Lined Copper Tube: ASTM B 280, seamless, annealed, with interior tin-plated lining. To be used when natural gas composition contains more than 0.3 grains of hydrogen sulfide in 100 cu. ft. of gas.

1. Mechanical Compression Fittings: Zinc lined, including seals compatible with gas in the piping, and approved by authorities having jurisdiction.

D. Piping: Copper type K only. Pipe conforming to ASME B16.18 and B16.22.

1. Cold Press Pro*Press* Fitting: (1/2" to 2") Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be BUNA-N. Fittings shall have SC (Smart Connect) feature contour design. Fitting ambient temperature range from -40°F. to 150°F.

2.5 PROTECTIVE COATING

A. Furnish pipe and fittings with factory-applied, corrosion-resistant polyethylene coating for use in contact with materials that may corrode the pipe.

2.6 PIPING SPECIALTIES

A. Flexible Connectors: ANSI Z21.24, copper alloy.

B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.

2.7 SPECIALTY VALVES

A. Valves, NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

B. Valves, NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

C. Appliance Connector Valves: ANSI Z21.15 and CSA International listed.

1. Manufacturers:

a. American Valve Inc.
b. Conbraco Industries, Inc.; Apollo Div.
c. Legend Valve and Fitting, Inc.
d. Mueller Co.; Mueller Gas Products Div.
e. Watts Industries, Inc.; Water Products Div.

D. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig minimum pressure rating.

E. Gas Valves, NPS 2 and Smaller: ASME B16.33 and CSA International-listed bronze body and 125-psig pressure rating.

1. Manufacturers:

a. Flow Control Equipment, Inc.
b. Grinnell Corp.
c. Legend Valve and Fitting, Inc.
d. Milwaukee Valve Company.
e. Mueller Co.; Mueller Gas Products Div.
f. NIBCO INC.
g. Red-White Valve Corp.
h. Watts Industries, Inc.; Water Products Div.

2. Tamperproof Feature: Include design for locking.

F. Plug Valves, NPS 2-1/2 and Larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.

1. Manufacturers:

a. Flow Control Equipment, Inc.
b. Nordstrom Valves, Inc.
c. Olson Technologies, Inc.; Homestead Valve Div.

2. Tamperproof Feature: Include design for locking.

G. General-Duty Valves, NPS 2-1/2 and Larger: ASME B16.38, cast-iron body, suitable for fuel gas service, with "WOG" indicated on valve body, and 125-psig pressure rating.

1. Gate Valves: MSS SP-70, OS&Y type with solid wedge.
2. Butterfly Valves: MSS SP-67, lug type with lever handle.

H. Automatic Gas Valves: ANSI Z21.21, with electrical & mechanical operator for actuation by appliance automatic shutoff device.

1. Manufacturers:

a. ASCO General Controls.
b. ASCO Power Technologies, LP; Division of Emerson.
c. GPS Gas Protection Systems Inc.
d. Honeywell International Inc.
e. Johnson Controls.

I. Electrically Operated Gas Valves: UL 429, bronze, aluminum, or cast-iron body solenoid valve; 120-V ac, 60 Hz, Class B, continuous-duty molded coil. Include NEMA ISC 6, Type 4, coil enclosure and electrically opened and closed dual coils. Valve position shall normally be closed.

1. Manufacturers:

a. ASCO General Controls.
b. ASCO Power Technologies, LP; Division of Emerson.
c. Magnatrol Valve Corp.
d. Watts Industries, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for propane gas piping system to verify actual locations of piping connections before equipment installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off propane gas to premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in affected piping section.

3.3 SERVICE ENTRANCE PIPING

A. Extend propane gas piping from underground storage tanks and connect to gas distribution for service entrance to building. Include 1st and 2nd stage regulators and all related shut-off valves and meters.

3.4 PIPING APPLICATIONS

A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.

B. Propane Gas Piping, 2 psig or Less:

1. NPS 1/2 and Smaller: NPS 3/4 steel pipe, malleable-iron threaded fittings, and threaded joints, Hard copper tube, copper fittings and brazed joints, Tin-lined copper tube, copper and mechanical compression fittings, and brazed joints or Corrugated, stainless-steel tubing system and threaded joints.

2. NPS 3/4 and NPS 1: Steel pipe, malleable-iron threaded fittings, and threaded joints, Hard copper tube, copper fittings, and brazed joints or Corrugated, stainless-steel tubing system and threaded joints.

3. NPS 1-1/4 to NPS 2: Steel pipe, malleable-iron threaded fittings, and threaded or steel welding fittings, and welded joints.
4. NPS 2-1/2 and Larger: Steel pipe, steel welding fittings, and welded joints.

C. Underground Propane Gas Piping: Steel pipe, steel welding fittings, and welded joints. Encase in containment conduit.

D. Containment Conduits: Steel pipe, steel welding fittings, and welded joints.

3.5 VALVE APPLICATIONS

A. Appliance Shutoff Valves for Pressure 0.5 psig or Less: Appliance connector valve or gas stop.

B. Piping Line Valves, NPS 2 and Smaller: Gas valve.

C. Piping Line Valves, NPS 2-1/2 and Larger: Plug valve or general-duty valve.

D. Valves at Service Meter, NPS 2 and Smaller: Gas valve.

E. Valves at Service Meter, NPS 2-1/2 and Larger: Plug valve.

3.6 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.

1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves above ceilings.
2. In Floors: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in floors, subject to approval of authorities having jurisdiction. Surround piping cast in concrete slabs with minimum of 1-1/2 inches (40 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Gas piping may be installed in floor channels, subject to approval of authorities having jurisdiction. Channels must have cover and be open to space above cover for ventilation.
4. In Partitions: Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside partitions or hollow walls.

    a. Exception: Tubing passing through partitions or walls.

5. In Walls: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in masonry walls, subject to approval of authorities having jurisdiction.
6. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

    a. Exception: Accessible above-ceiling space specified above.

C. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches (75 mm) long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.

D. 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.

E. Install propane gas piping at uniform grade of 0.1 percent slope upward toward risers.

F. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

G. Connect branch piping from top or side of horizontal piping.

H. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

I. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

J. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.

K. Install pressure gage upstream and downstream from each line pressure regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."

L. Install flanges on valves, specialties, and equipment having NPS 2-1/2 and larger connections.

M. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

N. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.7 JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Use materials suitable for propane gas.

1. Brazed Joints: Make with brazing alloy with melting point greater than 1000 deg F. Brazing alloys containing phosphorus are prohibited.

C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

D. Cold Press Pro*Press* Fitting: (1/2” to 2”) Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be BUNA-N. Fittings shall have SC (Smart Connect) feature contour design. Fitting ambient temperature range from -40°F to 150°F.

3.8 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 15 Section "Hangers and Supports."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
4. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

C. Install hangers for horizontal hard copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2 and NPS 5/8: Maximum span, 72 inches; minimum rod size, 3/8 inch NPS 3/4 and NPS 7/8: Maximum span, 84 inches; minimum rod size, 3/8 inch.
3. NPS 1: Maximum span, 96 inches; minimum rod size, 3/8 inch

D. Install hangers for horizontal corrugated, stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8 and NPS 1/2: Maximum span, 48 inches; minimum rod size, 3/8 inch
2. NPS 3/4 and NPS 1: Maximum span, 72 inches minimum rod size, 3/8 inch.
3. Option: Support tubing from structure according to manufacturer's written instructions.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.

B. Install piping adjacent to appliances to allow service and maintenance.

C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

E. Ground equipment according to Division 16 Section "Grounding and Bonding."

1. Do not use gas pipe as grounding electrode.

F. Connect wiring according to Division 16 Section "Conductors and Cables."

3.10 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.

1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
2. Nameplates, pipe identification, and signs are specified in Division 15 Section "Mechanical Identification."

3.11 PAINTING

A. Use materials and procedures in Division 9 painting Sections.

B. Paint exterior service meters, pressure regulators, and specialty valves.

1. Color: Gray

3.12 FIELD QUALITY CONTROL

A. Test, inspect, and purge piping according to NFPA 54 and requirements of authorities having jurisdiction.

B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

C. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.

D. Verify correct pressure settings for pressure regulators.

E. Verify that specified piping tests are complete.

END OF SECTION 23 11 15

SECTION 23 11 23 - 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. Service meters.
7. Concrete bases.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
2. Service Regulators: 100 psig (690 kPa) minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig (34.5 kPa).

B. Natural-Gas System Pressure within Buildings: More than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa.)

1.5 SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   3. Pressure regulators. Indicate pressure ratings and capacities.
   4. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars and supports.
   5. Dielectric fittings.

B. 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.

C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

D. Welding certificates.

E. Field quality-control reports.

1.6 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.

1.7 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.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. 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 Construction Manager or 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 Construction Manager's or Owner's written permission.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

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. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. 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. Steel flanges and tube with epoxy finish.
    c. Buna-nitrile seals.
    d. 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.

7. Steel Mechanical Couplings: Capable of joining 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. 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. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. 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: 60-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: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (86kPa). E.

T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig (5170 kPa).

F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

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. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground

Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. 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 "Underground Manual Gas Shutoff Valve Schedule" and "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.

C. General Requirements for Metallic Valves, NPS 2-1/2 (DN65) and Larger: Comply with ASME B 16.38.

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 "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. One-Piece, Bronze Ball Valve 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.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "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.

E. 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.
    e. Perfection Corporation; a subsidiary of American Meter Company.

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 "Underground Manual Gas Shutoff Valve Schedule" and "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.

F. 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.

G. 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. Homestead Valve; a division of Olson Technologies, Inc.
   c. McDonald, A. Y. Mfg. Co.
   d. Milliken Valve Company.
   e. Mueller Co.; Gas Products Div.
   f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.

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.

H. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

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. Dungs, Karl, Inc.
   c. Eaton Corporation; Controls Div.
   d. Eclipse Combustion, Inc.
   e. Honeywell International Inc.
   f. 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 automatic shutoff device.

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.
12. Maximum Inlet Pressure: 2 psig (13.8 kPa).

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

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. Canadian Meter Company Inc.
    b. Eaton Corporation; Controls Div. c.
    Harper Wyman Co.
    d. Maxitrol Company.
    e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig (13.8 kPa).

2.7 SERVICE METERS

A. Diaphragm-Type Service Meters: Comply with ANSI B109.1 or ANSI B109.2.

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. Invensys.

2. Case: Die-cast aluminum.
3. Connections: Steel threads.
4. Diaphragm: Synthetic fabric.
5. Diaphragm Support Bearings: Self-lubricating.
6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet and liters.
8. Meter Case and Index: Tamper resistant.
9. Remote meter reader compatible.
10. Maximum Inlet Pressure: 100 psig (690 kPa).
11. Pressure Loss: Maximum 0.5-inch wg (124 Pa).
12. Accuracy: Maximum plus or minus 1.0 percent.

B. Service-Meter Bars:

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. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Mueller Co.; Gas Products Div.
   f. Perfection Corporation; a subsidiary of American Meter Company.

2. Malleable- or cast-iron frame for supporting service meter.
3. Include offset swivel pipes, meter nuts with o-ring seal, and factory- or field-installed dielectric unions.
4. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.

C. Service-Meter Bypass 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. Lyall, R. W. & Company, Inc. b.
      Williamson, T. D., Inc.

2. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.

3. Integral ball-check bypass valve.

2.8 DIELECTRIC FITTINGS

A. 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.
McDonald, A. Y. Mfg. Co.
e. Watts Regulator Co.; Division of Watts Water Technologies, Inc. f.
Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig (1034 kPa).
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.9 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

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 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches (900 mm) below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774. D.

Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 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. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. 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.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. 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.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. 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.
5. Prohibited Locations:
    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. 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.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Division 05 Section "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install anode for metallic valves in underground PE piping.

3.7 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. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.8 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 23

Section "Hangers and Supports for HVAC Piping and Equipment."

C. 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).

3.9 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. 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.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

3.12 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. 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 the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig (20.7-MPa), 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 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.

3.14 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground, branch piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

END OF SECTION 23 11 23

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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 1 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. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 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.

C. Welding certificates.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 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."

1.6 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.

1.7 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Section "Roof Accessories."

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 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:

B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 2 to NPS 4 (DN 50 to DN 100) for Conventional Air-Conditioning Applications: Copper, Type L (B), drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:

1. NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
2. NPS 2 to NPS 3 (DN 50 to DN 80): Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
3. NPS 4 (DN 100): Copper, Type K (A), drawn-temper tubing and wrought-copper fittings with soldered joints.

D. Safety-Relief-Valve Discharge Piping: Copper, Type L (B), drawn-temper tubing and wrought-copper fittings with 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. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. 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.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. 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.

J. 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.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

L. Consult refrigeration equipment manufacturer to determine the need for a receiver.

M. Install receivers sized to accommodate pump-down charge.

N. 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. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective conduit where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. 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.

O. 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.

P. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:

1. Shot blast the interior of piping.
2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

R. Seal penetrations through fire and smoke barriers according to Section "Through-Penetration Firestop Systems."

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

U. Seal pipe penetrations through exterior walls according to Section "Joint Sealants" for materials and methods.

V. Identify refrigerant piping and valves according to Division 23.

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.

F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports."

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. 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. 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. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
2. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9.5 mm).
3. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (9.5 mm).
4. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

E. 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 23 29 23 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid-state, pulse-width modulated (PWM), variable frequency controllers (VFCs) for speed control of three-phase, squirrel-cage induction motors.

1.2 SUBMITTALS

A. Product Data: For each type of VFC.

B. Shop Drawings: For each VFC.

1. Include wiring diagrams.

C. Field quality-control test reports.

D. Operation and maintenance data.

E. Load-current and overload-relay heater list.

F. Load-current and list of settings of adjustable overload relays.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

B. Comply with NFPA 70.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:

1. Ambient Temperature: 0 to 40 deg C.
2. Humidity: Less than 90 percent (noncondensing).

1.5 COORDINATION

A. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Eaton Corporation; Cutler-Hammer Products.
3. General Electric Company; GE Industrial Systems.
4. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
5. Siemens Energy and Automation; Industrial Products Division.
6. Square D.
7. Toshiba International Corporation.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.

1. Provide unit suitable for operation of standard-efficiency motor as defined by NEMA MG 1.

B. 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.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:

1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Minimum Efficiency: 96 percent at 60 Hz, full load.
4. Minimum Displacement Primary-Side Power Factor: 96 percent.
5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
6. Starting Torque: 100 percent of rated torque or as indicated.
7. Speed Regulation: Plus or minus 1 percent.

E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

1. Electrical Signal: 4 to 20 mA at 24 V.
2. Pneumatic Signal: 3 to 15 psig (20 to 104 kPa).

F. 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: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.
5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

G. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.
2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class 10 performance.
4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
5. Instantaneous line-to-line and line-to-ground overcurrent trips.
6. Loss-of-phase protection.
7. Reverse-phase protection.
8. Short-circuit protection.
9. Motor overtemperature fault.

H. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

I. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

J. 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.

K. 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.

L. Input Line Conditioning:

M. VFC Output Filtering:

N. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

O. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

P. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

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 (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

Q. Control Signal Interface:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Pneumatic Input Signal Interface:
3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

    a. 0 to 10-V dc.
    b. 0-20 or 4-20 mA.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.
    e. RS485.
    f. Keypad display for local hand operation.

4. Output Signal Interface:

    a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:

        1) Output frequency (Hz).
        2) Output current (load).
        3) DC-link voltage (VDC).
        4) Motor torque (percent).
        5) Motor speed (rpm).
        6) Set-point frequency (Hz).

5. Remote Indication Interface: A minimum of 2 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.

R. Communications: Provide an RS485 interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.

S. Manual Bypass: Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable

operation (starting, stopping, and running), with motor completely disconnected from controller (no load).

T. Bypass Controller: NEMA ICS 2, full-voltage, nonreversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.

U. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.

V. Isolating Switch: Non-load-break switch arranged to isolate VFC and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

W. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

2.3 ENCLOSURES

A. Provide weatherproof NEMA 3R enclosure.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Standard Displays:

1. Output frequency (Hz).
2. Set-point frequency (Hz).
3. Motor current (amperes).
4. DC-link voltage (VDC).
5. Motor torque (percent).
6. Motor speed (rpm).
7. Motor output voltage (V).

F. 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.

G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to VFCs before shipping.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.

B. Select horsepower rating of controllers to suit motor controlled.

3.2 INSTALLATION

A. Install VFCs on concrete bases.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

C. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.3 IDENTIFICATION

A. Identify VFCs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

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.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation.
2. Assist in field testing of equipment.
3. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

END OF SECTION 23 29 23

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SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa). Metal ducts include the following:

1. Rectangular ducts and fittings.
2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.6 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices (if required).

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, liner material, 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.
13. Smoke and fire dampers
14. Soil, waste and vent piping
15. Medical gas piping
16. Roof drain piping
17. Domestic water piping
18. Sprinkler piping and heads
19. First paragraph below is defined in Division 1 Section "Submittal Procedures" as a "Delegated-Design Submittal." Retain with "Performance Requirements" Article if design responsibilities have been delegated to Contractor.

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.
5. Design Calculations: Calculations for selecting hangers and supports.

D. The Sheetmetal Subcontractor shall prepare a complete set of CAD generated background drawings on mylar sheet material at a scale not less than 3/8" equals 1'-0", showing structure, owner furnished equipment, etc., and other information as needed for coordination and noted above. They shall show sheetmetal layout thereon. These will be the Coordination Drawings.

E. 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. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. All firewalls and smoke partitions must be highlighted for appropriate coordination.
7. The main paths of egress and for equipment removal, from main mechanical/electrical rooms must be clearly shown.
8. Illustrate clear maintenance access, coil pull, and code required clearance for all equipment.
9. Illustrate code minimum required clearances between miscellaneous vents, exhaust air outlets and outdoor air intakes.
10. Coordinate final location of floor drains with housekeeping pads and equipment locations.
11. 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.

12. Where conflicts occur with placement of materials of various trades, the Sheetmetal Subcontractor will be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialed and dated by the specialty trade. The Sheetmetal Subcontractor shall then final date and sign each drawing. If he cannot resolve conflicts, the decision of the General Contractor shall be final.
13. After Approval:

a. All changes to approved coordination drawings shall be approved in writing by the Architect/Engineer prior to start of work in affected areas.

F. Welding certificates.

G. Field quality-control test reports.

1.7 DESIGN CRITERIA

A. All ventilation system products provided for this project shall conform to NFPA Section 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

B. All ductwork shall be installed as close as possible to wall and underside of beams and joists. Maintain 6" minimum clearance from rated walls.

C. Provide access for fire dampers and smoke detectors in ductwork.

D. Provide access panels up stream of all elbows with turning vanes and on discharge side of electrical heaters.

E. Provide access panels in ductwork for operation, adjustment and maintenance of all fans, valves and mechanical equipment.

F. Ceiling access panels shall be provided, where required, to service dampers, heaters, valves and other concealed mechanical equipment.

G. The inside of all ductwork visible through a grille or diffuser shall be painted flat black.

1.8 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 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 1-4, "Transverse (Girth) 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 1-5, "Longitudinal Seams - Rectangular Ducts," 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 2, "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."

2.3 DOUBLE-WALL RECTANGULAR DUCTS 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. McGill AirFlow LLC.
2. Sheet Metal Connectors, Inc.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) 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."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Inner Duct: Minimum 0.028-inch (0.7-mm).

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Traverse

(Girth) 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."

I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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."

2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class 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. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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."

1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.

2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," 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."

2.5 SHEET METAL MATERIALS

A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 (Z180) coating designation. Factory-applied PVC coatings shall be 4 mils (0.10 mm) thick on sheet metal surfaces of ducts and fittings exposed to corrosive conditions and 2 mils (0.05 mm) thick on opposite surfaces.

D. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

E. Stainless Steel: ASTM A 480/A 480M, Type 316 and having a No. 2D finish for concealed ducts and minimum No. 2 finish for exposed ducts.

F. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

H. 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).

2.6 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.7 HANGERS AND SUPPORTS

A. 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. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.8 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.
2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

2.9 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Fabricate ducts larger than 72 inches (1830 mm) in diameter with butt-welded longitudinal seams.

D. Duct Joints:

1. Ducts up to 20 Inches (500 mm) in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches (535 to 1830 mm) in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches (1830 mm) in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):

a. Ducts 3 to 36 Inches (75 to 915 mm) in Diameter: 0.034 inch (0.85 mm).
b. Ducts 37 to 50 Inches (940 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
c. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
d. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg (500 to 2500 Pa):

    a. Ducts 3 to 26 Inches (75 to 660 mm) in Diameter: 0.034 inch (0.85 mm).
    b. Ducts 27 to 50 Inches (685 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
    c. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
    d. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
8. Round Elbows Larger Than 14 Inches (355 mm) in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches (200 mm) in Diameter and All Pressures 0.040 inch (1.0 mm) thick with 2-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches (355 mm) in Diameter and Pressures through 10-Inch wg (2500 Pa): 0.022 inch (0.55 mm).

H. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:

1. Round Elbows 4 to 8 Inches (100 to 200 mm) in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.
2. Round Elbows 9 to 26 Inches (225 to 660 mm) in Diameter: Standing-seam construction.
3. Round Elbows 28 to 60 Inches (710 to 1525 mm) in Diameter: Standard gored construction, riveted and bonded.
4. Other Fittings: Riveted and bonded joints.
5. Couplings: Slip-joint construction with a minimum 2-inch (50-mm) insertion length.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts: 1-inch wg (250 Pa).

2. Supply Ducts (before Air Terminal Units): 2-inch wg (500 Pa).
3. Supply Ducts (after Air Terminal Units): 1-inch wg (250 Pa)
4. Supply Ducts (in Mechanical Equipment Rooms): 2-inch wg (500 Pa)
5. Return Ducts (Negative Pressure): 1-inch wg (250 Pa).
6. Exhaust Ducts (Negative Pressure): 1-inch wg (250 Pa).
7. Smoke Exhaust Ducts (Negative Pressure): 2-inch wg (500 Pa)

3.2 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. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

C. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.

D. Install ducts with fewest possible joints.

E. Install fabricated fittings for changes in directions, size, and shape and for connections.

F. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.

G. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

L. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

M. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

N. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or

duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).

O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

Q. Paint interiors of metal ducts, that do not have duct liner, for 24 inches (600 mm) upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 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, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," 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. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. 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).

3.6 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.

3.7 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.

B. Seal ducts before external insulation is applied.

3.8 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

3.9 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.10 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg (500 to 2500 Pa).
4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.
5. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
    b. Supply Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    c. Return Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections no less than 50 percent of total installed duct area for each designated pressure class.
    d. Exhaust Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections no less than 50 percent of total installed duct area for each designated pressure class.
    e. Outside Air Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections no less than 50 percent of total installed duct area for each designated pressure class.

6. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
7. Test for leaks before applying external insulation.
8. 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.
9. Give seven days' advance notice for testing.

B. 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.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.12 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems 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, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

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, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
5. 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.

F. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

3.13 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply, Outdoor Air, and Return Ducts:

1. Ducts Connected to Fan Coil Units, and Terminal Units:

a. Pressure Class: Positive 1-inch wg (250 Pa).
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 12.
d. Material: Galvanized Steel Duct.

2. 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: 12.

d. Material: Galvanized Steel Duct.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

a. Pressure Class: Positive 3-inch wg (750 Pa).
b. Minimum SMACNA Seal Class: A.
c. Material: Galvanized Steel Duct with fiber duct bond; As value Engineering Option upon Owner approval.

C. Exhaust Ducts (General):

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. Material: Galvanized Steel Duct.

D. Exhaust Ducts:

1. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

a. Exposed to View: Type 304, stainless-steel sheet.
b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
c. Welded seams and joints.
d. Pressure Class: Positive or negative 3-inch wg (750 Pa).
e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
f. SMACNA Leakage Class: 3.

2. Ducts Connected to Dishwasher Hoods:

a. Type 304, stainless-steel sheet.
b. Exposed to View: No. 4 finish.
c. Concealed: No. 2D finish.
d. Welded seams and flanged joints with watertight EPDM gaskets.
e. Pressure Class: Positive or negative 3-inch wg (750 Pa).
f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
g. SMACNA Leakage Class: 3.

3. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg (500 Pa)
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12
d. SMACNA Leakage Class for Round and Flat Oval: 6

E. Bath or Shower Exhaust Ducts:
1. Use aluminum sheet with all joints and seams sealed with duct sealant or welded for water tightness.

2. Use aluminum duct for exhaust from bath or shower rooms if they contain more than one bathtub or more than one shower head. The aluminum duct shall extend from the individual exhaust grilles to the exhaust fan. The exhaust fan discharge ductwork shall be aluminum or galvanized steel. All aluminum exhaust duct from the individual exhaust grilles to the exhaust fan shall be sealed with duct sealant or welded for water tightness.

F. Sterilizer Exhaust Ducts:
1. Use aluminum duct for exhaust from sterilizer piping spaces and for exhaust ducts and hoods located above sterilizer doors. All associated exhaust ductwork shall be air and watertight by means of duct sealant or welding.
2. Pitch ductwork back toward equipment.

G. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.

3. Aluminum Ducts: Aluminum.

H. Double-Wall Duct Interstitial Insulation (First 15’ of AHU/RTU supply):

1. Supply and Return Air Ducts: 1-1/2 inches (38 mm) thick.

I. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Velocity 1000 fpm (5 m/s) or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

c. Velocity 1500 fpm (7.6 m/s) or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "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 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 23 31 13

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SECTION 23 33 00 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. Motorized control dampers.
4. Fire Dampers
5. Combination Fire and Smoke Dampers
6. Turning vanes.
7. Duct-mounting access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

B. Related Sections include the following:
1. Division 23 Section "Instrumentation and Controls" for electric damper actuators.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Volume dampers.
3. Motorized control dampers.
4. Turning vanes.
5. Duct-mounting access doors.
6. Flexible connectors.
7. Flexible ducts.

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. Special fittings.
2. Manual-volume damper installations.
3. Motorized-control damper installations.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. 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).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers:

1. Air Balance, Inc.

2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
6. Penn Ventilation Company, Inc.
7. Prefco Products, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.

B. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch (150-mm) width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.

D. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum

E. Blade Seals: Vinyl

F. Blade Axles: Nonferrous

G. Tie Bars and Brackets: Aluminum.

H. Return Spring: Adjustable tension.

2.3 VOLUME DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized sheet steel.
3. Aluminum Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
6. Blade Axles: Galvanized steel
7. Bearings: Oil-impregnated bronze.
8. Tie Bars and Brackets: Aluminum.
9. Tie Bars and Brackets: Galvanized steel.

D. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat -shaped, galvanized sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized sheet steel.
3. Aluminum Frames: Hat -shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
6. Blade Axles: Galvanized steel
7. Bearings: Oil-impregnated bronze thrust or ball.
8. Blade Seals: Vinyl .
9. Jamb Seals: Cambered aluminum.
10. Tie Bars and Brackets: Aluminum.

E. Jackshaft: 1-inch- (25-mm-) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware: 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. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 MOTORIZED CONTROL DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
6. McGill AirFlow Corporation.
7. METALAIRE, Inc.
8. Nailor Industries Inc.
9. Penn Ventilation Company, Inc.
10. Ruskin Company.
11. Vent Products Company, Inc.

B. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch- (2.8-mm-) thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch- (1.61-mm-) thick, galvanized-steel damper blades with maximum blade width of 8 inches (203 mm).

1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
3. Provide closed-cell neoprene edging

2.6 FIRE DAMPERS

A. Manufacturers:

4. Air Balance, Inc.
5. CESCO Products.
6. Greenheck.
7. McGill AirFlow Corporation.
8. METALAIRE, Inc.
9. Nailor Industries Inc.
10. Penn Ventilation Company, Inc.
11. Prefco Products, Inc.
12. Ruskin Company.
13. Vent Products Company, Inc.
14. Ward Industries, Inc.

B. Fire dampers shall be labeled according to UL 555.

C. Fire Rating: 1-1/2 hours.

C. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

D. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick as indicated and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

E. Mounting Orientation: Vertical or horizontal as indicated.

F. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

G. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

H. Fusible Links: Replaceable, 165 deg F (74 deg C) rated.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:
1. Air Balance, Inc.
2. CESCO Products.
3. Greenheck.
4. Nailor Industries Inc.
5. Penn Ventilation Company, Inc.
6. Ruskin Company.

B. Combination fire and smoke dampers shall include automatic-reopening types to be part of an engineered smoke control system.

C. General Description: Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.

D. When smoke is detected (via a smoke detector), during testing or if power failure occurs, the damper will close and remain closed. When the smoke signal ceases (smoke detector reset), the test is completed or power is restored the damper will automatically RESET to the open position. The damper automatically resets if nuisance alarms occur and the system is reset.

E. The position of the damper to be shown in the fire command center or on a separate control panel. When closed, the damper CLOSED indicator light (on the separate control panel or in the fire command center) will light. The damper remains closed until an override signal for smoke management is initiated and the duct temperature has not exceeded the high limit.

F. A High Limit Temperature Sensor prevents the damper from reopening when duct temperature is above damper's UL555S degradation test temperature of 250°F/121°C or 350°F/177°C.

G. Upon cessation of the fire conditions, the damper can be reopened by pressing the RESET button located on the damper assembly.

H. Frame and Blades: 0.064-inch- (1.62-mm-) thick, galvanized sheet steel.

I. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.

J. Damper Motors: Modulating and two-position action.
1. Comply with requirements in Division 15 Section "Motors."

2. Electrical Connection: 115 V, single phase, 60 Hz.

2.5 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- (38-mm-) wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Duro Dyne Corp.
c. METALAIRE, Inc.
d. Ward Industries, Inc.

C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.6 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

1. Manufacturers:

a. American Warming and Ventilating.
b. CESCO Products.
c. Ductmate Industries, Inc.
d. Flexmaster U.S.A., Inc.
e. Greenheck.
f. McGill AirFlow Corporation.
g. Nailor Industries Inc.
h. Ventfabrics, Inc.
i. Ward Industries, Inc.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:

a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.
b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.
c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
d. Sizes 24 by 48 Inches (600 by 1200 mm) and Larger: One additional hinge.

C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch (25-mm) thickness. Include cam latches.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Flexmaster U.S.A., Inc.

2. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Pressure Relief Access Door: Single wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.

1. Manufacturers:

a. American Warming and Ventilating.
b. CESCO Products.
c. Ductmate Industries, Inc.
d. Greenheck.
e. KEES, Inc.
f. McGill AirFlow Corporation.
g. Nexus PDQ.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

F. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Corp.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches (146 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. Select metal compatible with ducts.

D. 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).

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

F. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd. (542 g/sq. m).
2. Tensile Strength: 285 lbf/inch (50 N/mm) in the warp and 185 lbf/inch (32 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

2.8 FLEXIBLE DUCTS (NON MEDICAL GRADE)

A. Manufacturers: Subject to compliance with requirements:

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, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1-2004

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. Non-Clamp Connectors: Liquid adhesive plus tape

2.9 FLEXIBLE DUCTS (NON MEDICAL GRADE)

A. Prohibited unless specifically noted on plans.

B. Insulated-Duct Connectors: 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 (20.3 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

C. Insulated-Duct Connectors: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor barrier film.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20.3 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 28 to plus 79 deg C).

D. Insulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate 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 (20.3 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 28 to plus 99 deg C).

E. Flexible Duct Clamps: Nylon strap, in sizes 3 through 18 inches (75 to 450 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 APPLICATION AND 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. Provide 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 backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

F. Provide test holes at fan inlets and outlets and elsewhere as indicated.

G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. On both sides of duct coils.
2. Downstream from volume dampers, turning vanes, and equipment.
3. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
4. On sides of ducts where adequate clearance is available.

H. Install the following sizes for duct-mounting, rectangular access doors:

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).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body Plus Ladder Access: 25 by 17 inches (635 by 430 mm).

I. Install the following sizes for duct-mounting, round access doors:

1. One-Hand or Inspection Access: 8 inches (200 mm) in diameter.
2. Two-Hand Access: 10 inches (250 mm) in diameter.
3. Head and Hand Access: 12 inches (300 mm) in diameter.
4. Head and Shoulders Access: 18 inches (460 mm) in diameter.
5. Body Access: 24 inches (600 mm) in diameter.

J. Install the following sizes for duct-mounting, pressure relief access doors:

1. One-Hand or Inspection Access: 7 inches (175 mm) in diameter.
2. Two-Hand Access: 10 inches (250 mm) in diameter.
3. Head and Hand Access: 13 inches (330 mm) in diameter.
4. Head and Shoulders Access: 19 inches (480 mm) in diameter.

K. Label access doors according to Division 23 Section "Mechanical Identification."

L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

M. For fans developing static pressures of 5-inch wg (1250 Pa) and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

Q. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23 33 00

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SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Utility Set fans.
2. Centrifugal roof ventilators.
3. Ceiling-mounting ventilators.
4. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on 100’ sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

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.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. 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.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 UTILITY SET FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carnes Company HVAC.
2. Greenheck
3. Loren Cook Company.
4. New York Blower Company (The).
5. Penn Ventilation.
6. Trane.

B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

C. Housing: Fabricated of galvanized steel with side sheets continuously or welded to scroll sheets.

1. Housing Discharge Arrangement: Upward.

D. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.

1. Blade Materials: Steel.
2. Blade Type: Airfoil.
3. Spark-Resistant Construction: AMCA 99, Type A.

E. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

F. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{50} of 200,000 hours.

G. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.5.
2. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
4. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

H. Accessories:
1. UL Label – Power ventilator for smoke control systems at 500°F (260°C) for a minimum of 4 hours and 1000°F (537°C) for a minimum of 15 years.
2. Inlet and Outlet: Flanged.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Access Door: Gasketed door in scroll with latch-type handles.
5. Drain Connections: NPS 3/4 (DN 20) threaded coupling drain connection installed at lowest point of housing.
6. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
7. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

I. Coatings: Powder-baked enamel.

1. Vibration Isolators:

a. Type: Restrained spring isolators.

b. Static Deflection: 3 inches.

2. Spark Arrestance Class: A.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Mfg. Corp.
2. Broan Mfg. Co., Inc.
3. Carnes Company HVAC.
4. Greenheck.
5. Loren Cook Company.
6. NuTone Inc.
7. Penn Ventilation.
8. Quietaire Corporation.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain drain and grease collector.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside outside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Built-in raised cant and mounting flange.
2. Overall Height: 12 inches (300 mm).
3. Sound Curb: Curb with sound-absorbing insulation matrix.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.

2.3 CEILING-MOUNTING VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Broan Mfg. Co., Inc.
2. Carnes Company HVAC.

3. Greenheck.
4. Loren Cook Company.
5. NuTone Inc.
6. Penn Ventilation.

B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Motion Sensor: Motion detector with adjustable shutoff timer.
5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
6. Filter: Washable aluminum to fit between fan and grille.
7. Isolation: Rubber-in-shear vibration isolators.
8. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.4 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Mfg. Corp.
2. Breidert Air Products.
3. Carnes Company HVAC.
4. Greenheck.
5. Loren Cook Company.
6. Penn Ventilation.
7. Quietaire Corporation.

B. Description: In-line, direct or belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing;

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.5 MOTORS

A. Enclosure Type: Totally enclosed, fan cooled.

2.6 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, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using restrained elastomeric mounts or spring isolators having a static deflection of 1 inch (25 mm). Vibration- devices are specified in Division 23 Section "Mechanical Vibration Controls."

1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.

C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 7 Section "Roof Accessories" for installation of roof curbs.

D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

E. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Mechanical Vibration Controls."

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Division 23 Section "Mechanical Identification."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

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, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END SECTION 23 34 23

SECTION 23 36 00 - AIR TERMINAL UNITS

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. Shutoff, single-duct air terminal units.
   2. Diffuser-type air terminal units.
   3. Electric Duct Heaters

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

1.4 SUBMITTALS

A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.

   1. Air terminal units.
   2. Liners and adhesives.

3. Sealants and gaskets.
4. Seismic-restraint devices.

B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.
2. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

D. Coordination Drawings: Reflected ceiling 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. Ceiling suspension assembly members.
2. Size and location of initial access modules for acoustic tile.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

E. Field quality-control reports.

F. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.5 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1 Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Powered-Unit Filters: Furnish one spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 SINGLE-DUCT AIR TERMINAL UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carnes.
2. Carrier Corporation.
3. Titus.

B. Configuration: Diverting-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: Double wall.

1. Casing Lining: Adhesive attached, 1-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

a. Cover liner with nonporous foil.

b. Cover liner with nonporous foil and perforated metal.

2. Casing Lining: Adhesive attached, 1-inch-thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
3. Air Inlet: Round stub connection for duct attachment.
4. Air Outlet: S-slip and drive connections.
5. Access: Removable panels for access to diverting damper and other parts requiring service, adjustment, or maintenance; with airtight gasket.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Diverter Assembly: Aluminum blade, with nylon-fitted pivot points.

E. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Access door interlocked disconnect switch.
2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
3. Nickel chrome 80/20 heating elements.
4. Airflow switch for proof of airflow.
5. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
6. Mercury contactors.
7. Pneumatic-electric switches and relays.
8. Magnetic contactor for each step of control (for three-phase coils).

F. Electric Controls: Damper actuator and thermostat.

1. Damper Actuator: 24 V, powered closed, powered open with microswitch to energize heating control circuit.
2. Thermostat: Wall-mounted electric type with temperature display in Fahrenheit and Celsius, and space temperature set point.
3. Changeover Thermostat: Duct-mounted, field-adjustable, electric type reverses action of zone thermostat when air temperature reaches 70 deg F.

G. Electronic Controls: Bidirectional damper operator and microprocessor-based thermostat. Control devices shall be compatible with temperature controls specified in Division 23 and shall have the following features:

1. Damper Actuator: 24 V, powered closed, powered open.
2. Thermostat: Wall-mounted electronic type with the following features:

a. Temperature set-point display in Fahrenheit and Celsius.
b. Auxiliary switch to energize heating control circuit.
c. Changeover thermistor to reverse action.

2.2 ELECTRIC RESISTANCE HEATING COILS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Dunham-Bush, Inc.
2. Indeeco
3. Trane

B. Testing Agency Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Coil Assembly: Comply with UL 1995.

D. Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium-oxide powder in tubular-steel sheath; with spiral-wound, copper-plated, steel fins continuously brazed to sheath.

E. Heating Elements: Open-coil resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, and fastened to supporting brackets.

F. High-Temperature Coil Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or casing.

1. Secondary Protection: Load-carrying, manually reset or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

G. Frames: Galvanized-steel channel frame, minimum 0.064 inch thick for flanged mounting.

H. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:

1. Magnetic contactor.
2. Mercury contactor.
3. Toggle switches; one per step.
4. Step controller.
5. Time-delay relay.
6. Pilot lights; one per step.

7. Airflow proving switch.

I. Thermostats: Wall-mounted temperature sensors, with temperature range from 50 to 90 deg F (10 to 32 deg C), and 2.5 deg F (1.4 deg C) throttling range capable of communication with building management system.

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Steel Cables: 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. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. 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.

3.3 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

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.

D. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
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.

E. Air terminal unit will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

END OF SECTION 23 36 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

D. Coordination Drawings: Reflected ceiling 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. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

E. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS, REGISTERS AND GRILLES

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers:
   a. Carnes.

b. Hart & Cooley, Inc.; Hart & Cooley Div.
c. Krueger.
d. METALAIRE, Inc.; Metal Industries Inc.
e. Price Industries.
f. Titus.
g. Tuttle & Bailey.

2. Material: Aluminum.
3. Finish: Baked enamel, white
4. Face Size: 24 by 24 inches (600 by 600 mm)
5. Face Style: Three cone
6. Mounting: T-bar
7. Pattern: Adjustable.
8. Dampers: Radial opposed blade Butterfly Combination damper and grid.
9. Duct Inlet: Round sizes indicated on drawings.
10. Accessories:

a. ½" thick foil backed insulation for mounting in hard ceiling
b. Plaster ring.

B. Eggcrate Diffuser:

1. Manufacturers:

a. Carnes.
b. Hart & Cooley, Inc.; Hart & Cooley Div.
c. Krueger.
d. METALAIRE, Inc.; Metal Industries Inc.
e. Price Industries.
f. Titus.
g. Tuttle & Bailey.

2. Material: Steel backpan and pattern controllers, with aluminum face.
3. Finish: Baked enamel, white
4. Face Size: 12 by 12 inches (300 by 300 mm) or 24 by 24 inches (600 by 600 mm) Duct Inlet: Round
5. Face Style: ½" x ½" x ½" eggcrate core.
6. Mounting: T-bar
7. Accessories:

a. Plaster ring for mounting in hard ceiling.

C. Louver Face Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Carnes.
b. METALAIRE, Inc.
c. Nailor Industries Inc.
d. Price Industries.
e. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Dampers: Radial opposed blade.

6. Accessories:

    a. Square to round neck adaptor.
    b. Adjustable pattern vanes.
    c. Throw reducing vanes.
    d. Equalizing grid.
    e. Plaster ring.
    f. Safety chain.
    g. Wire guard.
    h. Sectorizing baffles.
    i. Operating rod extension.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Bar Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Carnes.
    b. Krueger.
    c. METALAIRE, Inc.
    d. Nailor Industries Inc.
    e. Price Industries.
    f. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. One-Way Deflection Vanes: Extruded construction fixed louvers with removable core.
6. Damper Type: Adjustable opposed-blade assembly.

B. Linear Slot Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Carnes.
    b. Krueger.
    c. METALAIRE, Inc.
    d. Nailor Industries Inc.
    e. Price Industries.
    f. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Shell: Aluminum.
4. Material - Pattern Controller and Tees: Aluminum.
5. Finish - Face and Shell: Baked enamel, black.
6. Number of Slots: Two.
7. Length: 48 inches (1200 mm).

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 41 00 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.3 DEFINITIONS

A. DOP: Dioctyl phthalate or bis-(2-ethylhexyl) phthalate.

B. HEPA: High-efficiency particulate air.

C. ULPA: Ultra low penetration air.

1.4 SUBMITTALS

A. Product Data: Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.

1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.

C. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air filters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Comply with ARI 850.

C. Comply with ASHRAE 52.1 and ASHRAE 52.2 for method of testing and rating air-filter units.

D. Comply with NFPA 70 for installing electrical components.

E. Comply with NFPA 90A and NFPA 90B.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide one complete set of filters for each filter bank. If system includes prefilters, provide only prefilters.
2. Provide one container of red oil for inclined manometer filter gage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Air Filters:

a. AAF International.
b. Filtration Group.
c. Airguard Industries, Inc.
d. Barnebey & Sutcliffe Corp.
e. Columbus Industries, Inc.
f. CRS Industries, Inc.; CosaTron Div.
g. D Mark Inc.
h. Farr Co.
i. Flame Gard, Inc.
j. Flanders/CSC Corp.
k. Flanders Filters, Inc.
l. General Filters Inc.
m. International Air Filtration Corporation.
n. Koch Filter Corporation.
o. LakeAir International, Inc.
p. NiCon Filter Corp.; Continental Air Filter Div.
q. Purafil, Inc.
r. Research Products Corp.

2. Filter Gages:

a. Airguard Industries, Inc.
b. Dwyer Instruments, Inc.

2.2 DISPOSABLE PANEL FILTERS

A. Description: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with holding frames.

B. Media: Interlaced glass fibers sprayed with nonflammable adhesive

C. Frame: Cardboard frame with perforated metal retainer

D. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

2.3 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS

A. Description: Factory-fabricated, dry, extended-surface filters with holding frames.

B. Media: Fibrous material formed into deep-V-shaped pleats with anti-microbial agent and held by self-supporting wire grid.

C. Media and Media-Grid Frame: Nonflammable cardboard

D. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

2.4 EXTENDED-SURFACE, NONSUPPORTED-MEDIA FILTERS

A. Description: Factory-fabricated, dry, extended-surface, self-supporting filters with holding frames.

B. Media: Fibrous material constructed so individual pleats are maintained in tapered form by flexible internal supports under rated-airflow conditions.

C. Filter-Media Frame: Galvanized steel.

D. Duct-Mounting Frames: Welded galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

2.5 FLAT PANEL FILTERS

A. Description: Factory-fabricated, self-supported, flat, nonpleated, panel-type, disposable air filters with holding frames.
1. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:

a. AAF International.
b. Airguard.
c. Camfil Farr.
d. Columbus Industries, Inc.
e. CRS Industries, Inc.; CosaTron Division.
f. D-Mark.
g. Filtration Group.
h. Flanders-Precisionaire.

i. Koch Filter Corporation.
j. Purafil, Inc.
k. Research Products Corp.
l. Tri-Dim Filter Corporation.

B. Filter Unit Class: UL 900, Class 2.

C. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.

1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Media shall be coated with an antimicrobial agent.
3. Metal Retainer: Upstream side and downstream side.

D. Filter-Media Frame: Galvanized steel with metal grid on outlet side and steel rod grid on inlet side, hinged, with pull and retaining handles sealed or bonded to the media.

E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

F. Capacities and Characteristics:
1. Maximum or Rated Face Velocity: 500 Feet per Minute.
2. MERV Rating: 13 when tested according to ASHRAE 52.2.

2.6 FILTER GAGES

A. Description: Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.

1. Diameter: 4-1/2 inches (115 mm)
2. Range: 0- to 1.0-inch wg (0 to 250 Pa)

B. Manometer-Type Filter Gage: Molded plastic with epoxy-coated aluminum scale, logarithmic-curve tube gage with integral leveling gage, graduated to read from 0- to 3.0-inch wg (0 to 750 Pa), and accurate within 3 percent of full scale range.

C. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install filter frames according to manufacturer's written instructions.

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air.

D. Install filter gage for each filter bank.

E. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.

F. Coordinate filter installations with duct and air-handling unit installations.

G. Electrical wiring and connections are specified in Division 16 Sections.

H. Ground equipment according to Division 16 Section "Grounding and Bonding."

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components, filter and filter-frame installation, and electrical wiring, and to assist in field testing.

B. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg (750 Pa) or to designed operating pressure, whichever is higher; and test housing joints, door seals, and sealing edges of filter with soapy water to check for air leaks.

3.3 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 23 41 00

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SECTION 23 43 00 - AIR PURIFICATION SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. This section describes the design, performance and installation of an air purification system intended for use as part of another manufacturer's air handling unit or mounted on the duct as shown on the plans, details and equipment schedules.

1.2 REFERENCED CODES & STANDARDS

A. The following codes and standards are referenced throughout. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IBC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.

1. ASHRAE Standards 62 & 52
2. National Electric Code NFPA 70
3. UL 867

1.3 RELATED WORK

A. Testing, Adjusting and Balancing
B. Facility Access and Protection
C. Ductwork
D. Filters
E. Electrical Wiring
F. Control Wiring

1.4 QUALITY ASSURANCE

A. The Air Purification System shall be a product of an established manufacturer in the USA.

B. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.

C. Technologies that do not address gas disassociation such as UV lights, powered particulate filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. "Plasma" particulate filters shall not be acceptable.

D. Projects designed using ASHRAE Standard 62.1 *IAQ Procedure* shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1 to validate acceptable indoor air quality at the quantity of outside air scheduled. The manufacturer shall provide independent test data on a previous installation in a similar application that proves compliance to ASHRAE 62.1 and the accuracy of the calculations.

1.5 SUBMITTALS

A. Submit manufacturer's technical product data for ion generators including:

1. Schedule of plasma generators indicating model number and quantity of each type required for each unit/application.
2. Submittal sheet for each type of plasma generator and accessories furnished; indicating construction, dimensions, electrical data, and mounting details.

3. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1 to validate acceptable indoor air quality at the quantity of outside air scheduled (when projects are designed with reduced outside air).
4. Product drawings detailing all physical, electrical and control requirements.

B. Operating & Maintenance Data: Submit O&M data and recommended spare parts list.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of products shall be in factory fabricated shipping cartons. Identify on outside of carton the type of product contained within. Avoid crushing or bending.

B. Store in original cartons and protect from weather and construction work traffic.

C. Store indoors and in accordance with the manufacturers' recommendation for storage.

1.7 WARRANTY

A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twelve months after shipment or eighteen months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

PART 2 – PRODUCTS

2.1 GENERAL

A. The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit furnished and shall be manufactured by Plasma Air International (www.plasma-air.com) or approved equal.

B. All other suppliers of comparable products requesting prior approval shall:

1. Submit for prior approval in accordance with the requirements of this specification.
2. In addition, as part of the prior approval request, Bipolar Ionization manufacturers must submit their IAQ calculations that prove conformance to ASHRAE Standard 62.1 with the reduction of outside air to the scheduled values. A letter on the manufacturer's letterhead requesting prior approval must accompany the request for prior approval stating their calculations are ASHRAE compliant. A third party validation study performed on a previous installation of the same application shall also be included.

2.2 BI-POLAR IONIZATION DESIGN & PERFORMANCE CRITERIA

A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a plasma ion generator with bipolar ionization output as described here within.

B. The Bi-polar Ionization system shall be capable of:

1. Effectively killing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).
2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
3. Reducing static space charges.
4. Reducing space particle counts.

C. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.

1. Airflow rates may vary through the full operating range of a VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
2. Velocity Profile: The air purification device shall not have a maximum velocity profile.

D. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions to the air purification system.

E. Ionization Equipment Requirements:

1. Electrode Specifications (Bi-polar Ionization):

a. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity. Bipolar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time and corrosion.
b. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
c. Ionization output from each electrode shall be a minimum of 5 million ions/cc when tested at 2” from the ion generator.
d. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum.

2. Duct Mounted Units

a. Where so indicated on the plans and/or schedules, plasma ion generators shall be supplied and installed by the mechanical contractor. The contractor shall follow all manufacturer IOM instructions during installation.
b. Ion generators shall be furnished with a factory-equipped gasketed mounting flange to prevent duct leakage. A separate mounting plate may be utilized, but must be sealed to the duct with duct sealer or gasket material prior to install. The ionizer must be sealed to the plate.
c. Ion generators shall be installed in a convenient location for visual inspection, removal, and servicing. They shall include an ion indicator light clearly visible from below the installed location.

3. Certifications

a. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 867 – Electrostatic Air Cleaners.
b. The operation of the electrodes or bipolar ionization units shall conform to UL 867 with respect to ozone generation.

F. Electrical Requirements:

1. Ion generators shall contain a built-in power supply and operate on 24V AC and shall connect to the fan and common terminals of the air handling unit served.
2. If 24V AC is not available, a factory provided 120/230V AC to 12V DC power supply shall be field wired and installed in a junction box. Loose 24V AC to 12V DC converters shall be field mounted in a junction box with interconnecting wiring approved by the AHJ.

3. Wiring, conduit and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.

G. Control Requirements:

1. All plasma ion generators shall include internal short circuit protection, overload protection, and automatic fault reset. Manual fuse replacement shall not be accepted.
2. All plasma ion generators shall include an external BMS interface to indicate ion generator status and alarm.

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building (Owner Acceptance).

3.2 ASSEMBLY & INSTALLATION: PLASMA GENERATOR WITH BI-POLAR IONIZATION

A. All equipment shall be assembled and installed with a high level of workmanship to the satisfaction of the owner, architect and engineer.

B. Any material damaged by handling, water or moisture shall be replaced by the mechanical contractor at no cost to the owner.

C. All equipment shall be protected from damage on a daily basis throughout construction.

3.3 COMMISSIONING & TRAINING

A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

B. A portable hand held ion meter shall be provided to the owner with a range of 0 – 20,000 ions/cc and an accuracy of +/- 25% within the specified range.

END SECTION 23 43 00

SECTION 23 51 00 - 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. Field-fabricated metal breechings.

1.3 SUBMITTALS

A. Product Data: For the following:

   1. Field-fabricated metal breechings.

B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1.4 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 FIELD-FABRICATED METAL BREECHINGS AND CHIMNEYS

A. Fabricate chimneys and vent connectors from ASTM B 209 (ASTM B 209M), Type 1100 or 3003, aluminum or stainless steel, complying with NFPA 211 for the following minimum metal thicknesses:

   1. Aluminum: 0.027 inch (0.69 mm).
   2. Stainless Steel: 0.012 inch (0.31 mm).

B. Fabricate cleanout doors from compatible material, same thickness as breeching, bolted and gasketed.

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 INSTALLATION OF UNLISTED, FIELD-FABRICATED BREECHINGS AND CHIMNEYS

A. Suspend breechings and chimneys independent of their appliance connections.

B. Align breechings at connections, with smooth internal surface and a maximum 1/8-inch (3-mm) misalignment tolerance.

C. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

D. Lap joints in direction of flow.

E. Support breechings and chimneys from building structure with bolts, concrete inserts, steel expansion anchors, welded studs, C-clamps, or beam clamps according to manufacturer's written instructions.

3.3 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 23 51 00

SECTION 23 74 13 - PACKAGED, OUTDOOR, CENTRAL STATION ROOFTOP UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Heat-pump refrigeration components
   3. Hot-gas bypass.
   4. Economizer outdoor- and return-air damper section.
   5. Electric heating coils.
   6. Integral, space temperature controls.
   7. Roof curbs.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. 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.

F. 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.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

H. VVT: Variable-air volume and temperature.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Wind-Restraint Performance:
1. Basic Wind Speed: 170 mph
2. Unit curb must be provided with NOA Florida Approved number.

1.5 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 for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

D. 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
3. Roof curbs and flashing.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 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 ASHRAE/IESNA 90.1 for minimum efficiency of heating and cooling.

C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

D. UL Compliance: Comply with UL 1995.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 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.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-driven fan.
2. Filters: Two sets of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON, Inc.
2. Addison Products Company.
3. Carrier Corporation.
4. Daikin
5. Lennox Industries Inc.
6. McQuay International.
7. Trane; American Standard Companies, Inc.
8. Temptrol
9. 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: 0.079 inch (2.0 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 inch (25 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 stainless-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple both sides of drain pan.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

2.3 FANS

A. Direct-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed or ECM 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.

A. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

A. Supply-Air 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. Coil Split: Interlaced.
4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Two, or as scheduled.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief and crankcase heater.

C. Refrigeration Specialties:

1. Refrigerant Charge: R-410.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot gas reheat circuitry on units with electric resistance heat.
11. Hot gas bypass circuitry on units without heat and with multiple electric resistance heating coils

D. Electric-Resistance Heating:

1. 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. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
2. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
3. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.

4. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:

    a. Magnetic contactors.
    b. Step Controller: Pilot lights and override toggle switch for each step.
    c. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
    d. Time-delay relay.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2. Provide two pre-filters
    1. Pleated: Minimum 65 percent arrestance, and MERV 7.
    2. Flat Filter: Minimum 95 percent arrestance and MERV 13.

2.7 DAMPERS

A. 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.

2.8 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with control-circuit transformer with built-in overcurrent protection.

2.9 CONTROLS

A. DDC Controller:

1. Controller shall have volatile-memory backup and be compatible with existing campus Honeywell System.
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. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Section "Fire Alarm."
    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 365-day clock with a minimum of two programmable periods per day.
4. Unoccupied Period:

    a. Heating Setback: 60 deg F
    b. Cooling Setback: 78 degrees F.
    c. Override Operation: Three 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 discharge temperature and humidity. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
    b. Unoccupied Periods: Compressors off Cycle compressors and condenser fans for heating to maintain setback temperature.
    c. Switch reversing valve for heating or cooling mode on air-to-air heat pump.

7. Economizer Outdoor-Air Damper Operation:

   a. Occupied Periods: Open to 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. Use outdoor-air temperature to adjust mixing dampers. During economizer cycle operation, lock out cooling.
   b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

8. Electric Resistance Duct Heater Relays:

   a. Provide heating- and cooling-mode changeover relays compatible with above ceiling electric resistance duct heaters.

B. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet or LonWorks compatible interface for central HVAC control workstation for the following:

   a. Adjusting set points.
   b. Monitoring supply fan start, stop, and operation.
   c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
   d. Monitoring occupied and unoccupied operations.
   e. Monitoring constant and variable motor loads.
   f. Monitoring cooling load.
   g. Monitoring economizer cycles.
   h. Monitoring air-distribution static pressure and ventilation air volume.
   i. Monitoring gas furnace operation.

2.10 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Low-ambient kit using staged condenser fans for operation down to 35 deg F.

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Coil guards of painted, galvanized-steel wire.

2.11 ROOF CURBS

A. Roof curbs with vibration isolators meeting NOA Florida Approval.

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C 1071, Type I or II.
b. Thickness: 2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C 916, Type I.

C. Curb Height: 24 inches or as required to maintain 3’ clearance from outdoor intake hood to top of roof/roof insulation.

D. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.

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 RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts" and/or ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts.

B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

C. Install wind and seismic restraints according to manufacturer's written instructions.

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 RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Duct Accessories."
4. Install return-air duct 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 furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.

8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Verify lubrication on fan and motor bearings.
14. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
15. Adjust fan belts to proper alignment and tension.
16. 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.

17. Inspect and record performance of interlocks and protective devices; verify sequences.
18. Operate unit for an initial period as recommended or required by manufacturer.
19. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

20. Calibrate thermostats.
21. Adjust and inspect high-temperature limits.
22. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
23. Start refrigeration 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.

24. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
25. 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.

26. 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.

27. 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. Smoke and firestat alarms.

28. 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. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 23 74 13

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SECTION 23 74 33 - PACKAGED, OUTDOOR, HEATING AND COOLING MAKEUP AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Heat-pump refrigeration components
   3. Hot-gas bypass.
   4. Hot gas reheat.
   5. Economizer outdoor- and return-air damper section.
   6. Electric heating coils.
   7. Integral, space temperature controls.
   8. Roof curbs.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. 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.

F. 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.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

H. VVT: Variable-air volume and temperature.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Wind-Restraint Performance:
1. Basic Wind Speed: 170 mph
2. Unit curb must be provided with NOA Florida Approved number.

1.5 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 for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

D. 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
3. Roof curbs and flashing.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 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 ASHRAE/IESNA 90.1 for minimum efficiency of heating and cooling.

C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

D. UL Compliance: Comply with UL 1995.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 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.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-driven fan.
2. Filters: Two sets of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON, Inc.
2. Addison Products Company.
3. Des Champs Laboratories, Inc.
4. Daikin
5. Temptrol
6. Reznor-Thomas

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: 0.079 inch (2.0 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 inch (25 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 stainless-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple both sides of drain pan.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

2.3 FANS

A. Direct-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed or ECM 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.

A. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

A. Supply-Air 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. Coil Split: Interlaced.
4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Two.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief and crankcase heater.

C. Refrigeration Specialties:

1. Refrigerant Charge: R-410.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot gas reheat circuitry on units with electric resistance heat.

D. Electric-Resistance Heating:

1. 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. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
2. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
3. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
4. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:

a. Magnetic contactors.
b. Step Controller: Pilot lights and override toggle switch for each step.
c. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
d. Time-delay relay.

2.6 AIR FILTRATION

A. Extended-Surface, Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Factory-fabricated, dry, extended-surface type.
3. Thickness: 1 inch
4. Minimum Arrestance: 65 according to ASHRAE 52.1.
5. Minimum MERV: 7 according to ASHRAE 52.2.
6. Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.

B. Extended-Surface, Nonsupported-Media Filters:

1. Comply with NFPA 90A.
2. Factory-fabricated, dry, extended-surface, self-supporting type.
3. Minimum Arrestance: 95 according to ASHRAE 52.1.
4. Minimum MERV: 13 according to ASHRAE 52.2.
5. Media: Fibrous material coated with an antimicrobial agent and constructed so individual pleats are maintained in tapered form by flexible internal supports under rated-airflow conditions.

C. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Extended surface filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks with space for prefilter.

2.7 DAMPERS

A. 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.

2.8 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with control-circuit transformer with built-in overcurrent protection.

2.9 CONTROLS

A. DDC Controller:

1. Controller shall have volatile-memory backup and be compatible with existing campus Honeywell System.
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. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Section "Fire Alarm."
    c. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F.
    d. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.

3. Scheduled Operation: Occupied and unoccupied periods on 365-day clock with a minimum of two programmable periods per day.
4. Unoccupied Period:

    a. Heating Setback: 60 deg F.
    b. Cooling Setback: 78 degrees F.
    c. Override Operation: Three 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 discharge temperature and humidity. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
b. Unoccupied Periods: Compressors off Cycle compressors and condenser fans for heating to maintain setback temperature.
c. Switch reversing valve for heating or cooling mode on air-to-air heat pump.

7. Economizer Outdoor-Air Damper Operation:

a. Occupied Periods: Open to 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 temperature to adjust mixing dampers. During economizer cycle operation, lock out cooling.
b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

8. Electric Resistance Duct Heater Relays:

a. Provide heating- and cooling-mode changeover relays compatible with above ceiling electric resistance duct heaters.

B. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet or LonWorks compatible interface for central HVAC control workstation for the following:

a. Adjusting set points.
b. Monitoring supply fan start, stop, and operation.
c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
d. Monitoring occupied and unoccupied operations.
e. Monitoring constant and variable motor loads.
f. Monitoring cooling load.
g. Monitoring economizer cycles.
h. Monitoring air-distribution static pressure and ventilation air volume.
i. Monitoring gas furnace operation.

2.10 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.11 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Low-ambient kit using staged condenser fans for operation down to 35 deg F.

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Coil guards of painted, galvanized-steel wire.

2.12 ROOF CURBS

A. Roof curbs with vibration isolators meeting NOA Florida Approval.

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C 1071, Type I or II.
b. Thickness: 2 inches (50 mm).

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C 916, Type I.

C. Curb Height: 24 inches (610 mm) or as required to maintain 3’ clearance from outdoor intake hood to top of roof/roof insulation.

D. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.

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 RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts" and/or ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts.

B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

C. Install wind and seismic restraints according to manufacturer's written instructions.

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 RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Duct Accessories."
4. Install return-air duct 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 furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Verify lubrication on fan and motor bearings.
14. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
15. Adjust fan belts to proper alignment and tension.
16. 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.

17. Inspect and record performance of interlocks and protective devices; verify sequences.
18. Operate unit for an initial period as recommended or required by manufacturer.
19. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

20. Calibrate thermostats.

21. Adjust and inspect high-temperature limits.
22. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
23. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.

24. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
25. 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.

26. 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.

27. 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. Smoke and firestat alarms.

28. 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. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 23 74 33

SECTION 23 81 23 - COMPUTER-ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor-mounted computer-room air conditioners, 5 tons and smaller.

1.2 SUBMITTALS

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

B. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.

D. Field quality-control reports.

E. Operation and maintenance data.

1.3 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. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED UNITS 5 TONS AND SMALLER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Airflow Company; a division of The McClain Company, Inc.
2. Carrier Corporation; a United Technologies company.
3. Compu-Aire, Inc.
4. Data Aire Inc.
5. Koldwave, Inc.; a Mestek company.
6. Liebert Corporation.
7. McQuay International.
8. Stulz-ATS.
9. Trane; a business of American Standard Companies.

C. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for vertical floor mounting in upflow or downflow configuration.

D. Cabinet and Frame: Welded tubular-steel frame with removable steel panels with baked-enamel finish, insulated with 1-inch-thick duct liner.

1. Floor Stand: Welded tubular steel, with adjustable legs and vibration isolation pads.
2. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Supply-Air Fan: Forward curved, centrifugal, and with adjustable V-belt drive.

F. Refrigeration System:

1. Compressor: Hermetic, with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
2. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
3. Refrigerant: R-410A.
4. Refrigerant: R-407C or R-410A.

5. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins, with two circuits, each with solenoid valve.

    a. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1-2004 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir, where applicable.

6. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube aluminum-fin coil with propeller fan, direct driven.
7. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

G. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor and high-temperature-limit switches.

H. Filter: 2-inch-thick, disposable, glass-fiber media.

I. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

J. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature-and humidity-control modules, time-delay relay, Heating contactor, and high-temperature thermostat. Provide solid-state, wall-mounted control panel with start-stop switch, adjustable humidity set point, and adjustable temperature set point.

2.2 CONSOLE UNITS

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carrier Corporation; a United Technologies company.
2. Compu-Aire, Inc.
3. Data Aire Inc.
4. Koldwave, Inc.; a Mestek company.
5. Liebert Corporation.
6. McQuay International.
7. Stulz-ATS.
8. Trane; a business of American Standard Companies.

C. Description: Split system consisting of evaporator section for floor mounting and remote condensing section.

D. Evaporator Cabinet: Furniture-grade steel with baked-enamel finish; with front access and containing direct-drive centrifugal fans and two-speed motor.

1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Condenser Cabinet: Steel with baked-enamel finish and containing compressor and condenser.

F. Refrigeration System:

1. Compressor: Hermetic, with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
2. Refrigeration Circuit: Filter/dryer, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
3. Refrigerant: R-410A.
4. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.

    a. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir, where applicable.

5. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube aluminum-fin coil with propeller fan, direct driven.
6. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

G. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor and high-temperature-limit switches.

H. Filter: Cleanable.

I. Filter: 2-inch-thick, disposable, glass-fiber media.

J. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

K. Control System: Unit-mounted panel with contactors, control transformer with circuit breaker, and solid-state temperature-and humidity-control modules. Provide solid-state, unit-mounted control panel with start-stop switch, adjustable humidity set point, and adjustable temperature set point.

2.3 FAN MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. 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.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.

B. Computer-Room Air-Conditioner Mounting: Install using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Water and Drainage Connections: Comply with applicable requirements in Division 22 Section "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

D. Refrigerant Piping: Comply with applicable requirements in Division 23 Section "Refrigerant Piping." Provide shutoff valves and piping.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
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.

B. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

D. After startup service and performance test, change filters and flush humidifier.

3.4 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 6 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.

END OF SECTION 23 81 23

SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Field quality-control reports.

E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

F. Warranty: Sample of special warranty.

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. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: One year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

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(s) for each air-handling unit.
2. Fan Belts: One set(s) for each air-handling unit fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.

2. Daikin
3. LG
4. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
5. SANYO North America Corporation; SANYO Fisher Company.
6. Trane; a business of American Standard companies.
7. YORK; a Johnson Controls company.

2.2 INDOOR UNITS 5 TONS OR LESS

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
4. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm); leak tested to 300 psig (2070 kPa) underwater; with a two-position control valve.
5. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
7. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
9. Filters: Permanent, cleanable.
10. Condensate Drain Pans:

    a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
        1) Depth: A minimum of 2 inches (50 mm) deep.

b. Single-wall, stainless-steel sheet.
c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

1) Minimum Connection Size: NPS 1.

d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
c. Enclosure Type: Totally enclosed, fan cooled.
d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
f. Mount unit-mounted disconnect switches on exterior of unit.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
7. Condensate Drain Pans:

a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

1) Depth: A minimum of 1 inch (25mm) deep.

b. Single-wall, stainless-steel sheet.
c. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

1) Minimum Connection Size: NPS 1.

e. Pan-Top Surface Coating: Asphaltic waterproofing compound.

8. Air Filtration Section:

a. General Requirements for Air Filtration Section:

1) Comply with NFPA 90A.
2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

1) Factory-fabricated, viscous-coated, flat-panel type.
2) Thickness: 1 inch (25 mm).
3) Merv according to ASHRAE 52.2: 8.
4) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS 5 TONS OR LESS

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

a. Compressor Type: Scroll.
b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant Charge: R-410A.
d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

F. Drain Hose: For condensate.

G. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.

3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounted, compressor-condenser components on 4-inch-thick, reinforced concrete base that is 4 inches larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

D. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

E. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

F. Install seismic restraints.

G. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch.

H. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 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.

B. Perform tests and inspections.

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.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

END OF SECTION 23 81 26

SECTION 26 05 00 - GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

A. The accompanying General Conditions shall apply to and form a part of this Specification.

1.2 GENERAL REQUIREMENTS:

A. Carefully examine General Conditions, other specification sections, and other drawings (in addition to DIVISION 26), in order to be fully acquainted with their effect on electrical work.

B. Do all work in compliance with the latest adopted edition of the Florida Building Code, NFPA 70 (NEC) and NFPA 101 (Life Safety Code), NFPA 99 (Healthcare Code), Americans with Disabilities Act (ADA) ANSI A117.1, FGI Guidelines For the design and construction of patient care facilities, regulations of the Agency for Healthcare Administration (AHCA) 58a-5 and FC –Chapter 400 and the regulations of the local telephone, cable television and Gulf Power utility companies. Obtain and pay for any and all required permits, inspections, certificates of inspections and approval, and the like, and deliver such certificates to the Engineer.

C. Cooperate and coordinate with other trades and contractors at job. Perform work in such manner and at such times as not to delay work of other trades. Complete all work as soon as the condition of the structure and installations of equipment permit. Patch, in a satisfactory manner and by the proper craft, any work damaged by electrical workmen.

D. The Contractor shall furnish, perform, or otherwise provide all labor (including, but not limited to, all planning, purchasing, painting, transporting, rigging, hoisting, storing, installing, testing, chasing, channeling, cutting, trenching, excavating and backfilling), coordination, field verification, equipment installation, support, and safety, supplies, and materials necessary for the correct installation of complete and functional electrical systems (as described or implied by these specifications and the applicable drawings).

1.3 DRAWINGS:

A. Indicate only diagrammatically the extent, general character, and approximate location of work. Where work is indicated, but with minor details omitted, furnish and install it completely and so as to perform its intended functions. For building details and mechanical equipment, follow architectural, structural, and mechanical drawings and fit electrical work thereto.

B. All drawings and specifications on the project are complementary, each to all other sets, and they shall be used in combination for the execution of this work. DIVISION 26 work shown on any one set of drawings, including all architectural drawings, mechanical, plumbing and fire protection drawings for general work and equipment, and DIVISION 26 work called for under any section of the project specifications, shall be considered as included in this work unless specifically excluded by inclusion in some other branch of the work. This shall include roughing-in for connections and equipment as called for or inferred. The Contractor shall check all drawings and specifications for the project and shall be responsible for the installation of all DIVISION 26 work.

C. Take finish dimensions at the job preference to scale dimensions. Where specific details and dimensions for DIVISION 26 work are not shown on the drawings, the Contractor shall take measurements and make layouts as required for the proper installation of the work and coordination with all drawings and coordination with all other work on the project. In case of any discrepancies between the drawings and the specifications that have not been clarified by addendum prior to bidding, it shall be assumed by the signing of the contract that the higher cost (if any difference in costs) is included in the contract price, and the Contractor shall perform the work

in accordance with the drawings or with the specifications, as determined and approved by the Engineer, and no additional costs shall be allowed to the base contract price.

D. Except as noted above, make no changes in or deviations from the work as shown or specified unless approved by the Engineer.

E. The Contractor shall carefully check the drawings and specifications of all other trades and divisions before installing any of his work. He shall in all cases consider the work of all other trades and shall coordinate his work with them so that the best arrangements of all equipment, piping, conduit, ducts, rough-in, etc., can be obtained.

F. Locations designated for outlets, switches, devices, equipment, etc., are approximate and final locations shall be verified in the field. Contractor shall locate all devices up to 15'-0" in any direction as directed by Owner and per Code. Where instructions or notes are insufficient to convey the intent of the design, consult the Owner prior to bidding and installation.

G. Obtain manufacturer's data on all equipment, the dimensions of which may affect electrical work. Use this data to coordinate proper service characteristics, entry locations, etc., and to ensure minimum clearances are maintained.

H. Contractor shall be responsible for verifying and coordinating the locations of devices to be used and coordinating the final locations of electrical equipment with millwork, sinks, benches, counters and shelving prior to bidding and installation. All discrepancies shall be brought to the attention of the Owner prior to bidding.

1.4 QUALIFICATIONS OF CONTRACTOR:

A. DIVISION 26 Contractor shall have had experience of at least the same size and scope as this project, on at least two other projects within the last five years in order to be qualified to bid this project.

B. Workmen shall be experienced in their respective trade. Workmanship of installed work shall be first class and will be judged by the Engineer. Substandard work shall be removed and replaced.

1.5 SITE VISIT:

A. The Contractor shall visit the site of this contract prior to bidding and shall thoroughly familiarize himself with all existing field conditions and the proposed work as described or implied by the contract documents. During the course of his site visit, the Contractor shall verify every aspect of the proposed work and the existing field conditions in the areas of construction which might affect his work. The Contractor shall receive no compensation or reimbursement for additional expenses he incurs due to his failure or neglect to make a thorough investigation of the contract documents, existing site conditions, and the existing facilities prior to bidding.

1.6 WARRANTY:

A. Contractor shall and does hereby warrant all materials and equipment furnished under this section of the specifications to be free from defects and to function or operate satisfactorily for one year after final acceptance of the work, and that any items not meeting this requirement will be made good by him without cost to Owner, provided such defects or failures are not due to abuse, neglect, or lack of reasonable and ordinary maintenance.

PART 2 - PRODUCTS

2.1 APPROVED MATERIALS AND DEVICES:

A. Where not otherwise specified, provide only new, standard first-grade materials throughout, conforming to standards established by Underwriters' Inc., and so marked and labeled, together with manufacturer's brand or trademark.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

A. Do all work in compliance with the latest adopted edition of the Florida Building Code, NFPA 70 (NEC) and NFPA 101 (Life Safety Code), NFPA 99 (Healthcare Code), Americans with Disabilities Act (ADA) ANSI A117.1, FGI Guidelines For the design and construction of patient care facilities, regulations of the Agency for Healthcare Administration (AHCA) 58a-5 and FC –Chapter 400 and the regulations of the local telephone, cable television and Power utility companies. Obtain and pay for any and all required permits, inspections, certificates of inspections and approval, and the like, and deliver such certificates to the Engineer.

B. All work shall be executed in a workmanship manner and shall present a neat mechanical appearance upon completion.

C. Care shall be exercised that all electrical and Division 26 items are plumb, straight, level.

D. Care shall be exercised so that Code clearance is allowed for all panelboards, disconnects, controls, equipment, etc., requiring it. Do not allow other trades to infringe on this clearance.

E. Balance load as equally as practicable on all feeders, branch circuits and panel buses.

F. The DIVISION 26 trades shall cooperate and confer with all other trades on the project, as to locations and requirements of their materials and equipment before erecting the work so as to avoid interference and delay in progress of construction. In instances where interference may develop, the Contractor shall relocate his work as approved by the Engineer, to depart from such interferences at no additions to the contract price. Where it is necessary to make adjustments in the locations or routing of conduits, wireways, or other installations (from that shown on the drawings) to clear obstructions or other installed work, the Contractor shall be responsible for making these adjustments as a part of the contract work.

G. The Contractor shall review the Contract Documents of ALL trades and shall coordinate work with all other trades as required to avoid installation and connection conflicts and interferences. All work shall be preplanned. Any conflicts or interferences which cannot be resolved shall be referred to the Engineer prior to installation of the equipment. A failure to obtain assistance from the Engineer prior to installation in order to correct a deficiency shall mean that the Contractor shall correct the deficiency at no additional cost to the Owner.

H. The Contractor shall keep the construction site clean of all waste materials and rubbish caused by his work or employees. Upon completion of the work and at times during progress of the work when requested by the Engineer, the Contractor shall remove all surplus materials, rubbish, and debris resulting from the operation, and shall leave the entire building and involved portions of the site, insofar as the work of the contract is concerned, in a neat, clean, and acceptable condition as approved by the Engineer. Equipment, lighting fixtures, materials and accessories shall be thoroughly cleaned of cement, plaster, and other materials.

I. The Contractor shall provide adequate protection wherever work is to be performed in finished/occupied spaces, to prevent damage to adjacent areas, to prevent power outages, equipment, or furnishings; to prevent accidental injury to building occupants and the public; to prevent the spreading of dust, dirt, debris, and moisture from the area where work is being performed; and to prevent dust, dirt, debris, and moisture from getting on or in the building occupant's furnishings or equipment.

J. The Contractor shall repair, at no cost to the Owner, any damage done by himself or his employees. He shall also be responsible for all cutting and patching required to properly install his work. This shall also include the patching of existing roadways (paved or improved), parking areas, sidewalks, walls, stairs, mechanical work, curbs, gutters, etc., cut to install work provided by the Contractor. Patch work shall comply with the applicable sections of these specifications and shall match the existing finishes.

3.2 ACCEPTANCE TESTING:

A. Upon completion of work, the entire wiring system shall be tested, and shall be shown to be in proper working condition in accordance with intent of specifications and drawings. It shall be the responsibility of the Contractor to have all systems ready for operation and to have an electrician available to operate same in accordance with and under the supervision of the inspection representative of the Engineer. The Contractor shall be available to assist in removal of panel fronts, etc., to permit inspection as required.

3.3 AS-BUILT DRAWINGS:

A. In accordance with DIVISION 1 and the Conditions of the Contract, the Contractor shall provide and keep up to date a complete record set of construction "As-Builts" blueline prints which shall be corrected daily and shall show every change from the original contract drawings, including addenda and change orders in accordance with General Requirements and Special Conditions. This set of prints shall be kept on the job site and shall be used only as a record set. All updates, changes, addendums etc. shall be transferred to the Revit or AutoCAD model by the Contractor and the final annotated drawings and electronic files turned over to the owner. This shall not be construed as authorization for the Contractors to make changes in the layout without definite instruction in each case.

END OF SECTION 26 05 00

SECTION 26 05 01 - ELECTRICAL SCOPE

PART 1 - GENERAL

1.1 SCOPE:

A. Work Required:

1. Furnishing and installation of electric lighting, lighting dimming and control systems, power systems, and auxiliary systems as shown or herein specified.

2. Furnishing and installation of all electrical items shown on drawings or herein specified, unless shown or specified otherwise.

3. Furnishing and installation of disconnect switches and motor starters for motors and equipment unless equipment is equipped integral with the equipment or specified under another division.

4. Connection of all equipment requiring electrical connection, mentioned in this division or shown on all other drawings, whether furnished by Division 26 or under other divisions, or furnished by Owner.

5. Furnishing and installation of outlet boxes, conduit raceways, terminal boards, terminal cabinets, power, and grounding for a complete Security, Nurse call, Telephone, Sound and data raceway distribution system. (Telephone and data wiring and hardware, as well as wiring and software are not included.).

6. Furnishing and installation of emergency and exit lighting systems.

7. Furnishing and installation of building grounding systems.

8. Receive, offload, install and connect all Owner provided equipment and devices as stated on the contract documents including all kitchen equipment.

9. Furnish, install and connect all power connections to all electrical equipment. Provide in the field coordination of all connections.
10. Furnish and install a complete AHCA approved power emergency standby generator and automatic transfer switch system including electrical distribution.
11. Furnish, install and connect a complete rooftop Lightning Protection system.

12. Furnish and install a complete AHCA approved Voice evacuation type fire alarm system.

13. The Contractor shall be fully responsible for contacting the offices of all local and/or state authorities having jurisdiction over this project including AHCA in order to schedule all required inspections and obtain all necessary permits, etc. The Contractor shall notify the Architect/Engineer of all scheduled inspections at least two weeks in advance of the scheduled date.

14. The Contractor shall obtain and pay for any and all required permits, inspections, certificates of inspections and approval. He shall also pay for all connection charges or "aids to construction" charges assessed by the local utilities. These costs shall all be included in his bid price.

15. The Contractor shall obtain all necessary certificates issued by the authorities having jurisdiction over the work. The inspection certificates shall be received by the Architect/Engineer before work will be approved for final payment.

16. The Contractor shall replace any defective materials, equipment, or workmanship without cost to the Owner within the stipulated guaranteed period.

17. The Contractor is responsible for coordinating and programming the work of all trades and the responsibility of having their crews and materials available at the proper time in conjunction with the project schedule and all other trades.

18. The work shall include revisions, modifications, and rework of the existing facility and systems as required for installation of new work, and for connections between existing work and new work where required. The work shall also include the completion of electrical power and control circuits, for devices and equipment that are to remain in service, if the circuits are broken by demolition work, or by the removal or cutting of existing building construction, existing devices or equipment. Existing conduit wiring shall be rerouted and reconnected where necessary.

19. Each bidder shall inspect the site as required for knowledge of existing conditions prior to bidding and failure to obtain such knowledge shall not relieve the successful bidder of the responsibility to meet existing conditions in performing the work under this contract.

20. Where new work cannot be installed without changes in existing facility or systems or where it is indicated on drawings to rework an existing installation, this contract shall include alterations to existing work as required to install new work. Additions to the contract cost will not be allowed because of this Contractor's failure to inspect existing conditions at the site of the work.

21. Existing conditions indicated on the drawings are taken from the best information available on previous contract drawings and from visual site inspection and are not to be construed as "As-Built" conditions but are to indicate the intent of this work. It shall be the responsibility of the Contractor to verify all existing conditions at the project site prior to bidding and to perform the work as required to meet the existing conditions and the intent of this work indicated.

22. Existing material and equipment removed from existing construction and not shown or required to be reused shall become the property of the Contractor, unless otherwise noted or indicated and shall be promptly and legally removed from the site.

23. Any existing material or equipment which is to be reused or left in place and is damaged by performance of work under this contract shall be repaired or shall be replaced with new equipment and material at the expense of the Contractor, to the satisfaction of the Architect/Engineer and/or Owner's authorized representative.

24. It shall be the responsibility of the Division 26 Contractor to have all systems ready for operation and to have an electrician available for all inspections. The Contractor shall provide personnel to assist in removal of panel fronts, etc. to permit inspection as required.

25. Contractor shall be responsible for all pre- coordination of the Power, Telephone and Cable television utilities and plan and coordinate all incoming demarcation and primary and secondary systems conduits. Contractor shall provide and install all demarcation conduits as shown on the drawings for all systems.

26. The basis of design for the switchgear and short circuit analysis is Square D. If the contractor utilizes a different approved manufacturer the contractor must provide a complete electrical system short circuit analysis and coordination study and is responsible for providing coordination as per the requirements of the NEC and all

applicable AHCA requirements. The Contractor will be responsible for all obtaining AHCA approval and shall include all costs associated with such work including costs of engineering and or signing and sealing of reports and studies.

PART 2 - PRODUCTS

2.1 SHOP DRAWINGS:

A. Submit to the Architect/Engineer promptly after award of contract and prior to purchasing, six copies of manufacturer's shop drawings in accordance with DIVISION 1, SECTION 013000 - SUBMITTALS for the following items. All shop drawings of a specific item or system shall be made in one submittal and within ten days after award of contract.

1. Panelboards
2. Lighting Fixtures
3. Fire Alarm Systems
4. Wiring Devices
5. Disconnect Switches
6. Surge Protection Devices (SPD)
7. Lightning Protection system
8. Lighting Controls
9. Generator
10. Automatic Transfer switch
11. Switchboard
12. Generator Quick connect equipment

B. Provide certification that all other items are as specified.

C. The Architect/Engineer will return the shop drawing submittals with a stamp indicating approval, approved as noted, etc.

D. Provide copies of all approved shop drawings with "As-Built" drawings.

2.2 SUBMITTALS:

A. All materials and equipment shall be submitted by manufacturer, trade name and model number. The submittal shall include copies of applicable brochure or catalog material for all items. The Contractor shall not assume that applicable catalogs are available in the Architect/Engineer's office. Maintenance and operating manuals are not suitable submittal material. Each sheet of printed submittal material shall be clearly marked (using arrows, underlining, or circling) to show the particular sizes, types, model numbers, rating, capacities, and options actually being proposed. Non-applicable material shall be crossed out. All specified features must be specifically noted on the submittal. See DIVISION 1 for requirements concerning shop drawing and brochure submittals.

PART 3 - EXECUTION

3.1 MOTORS, STARTERS AND CONTROLS:

A. Unless otherwise specified or shown, all motors will be furnished and installed under other divisions of these specifications. All power wiring to motor starters and motors shall be under DIVISION 26.

B. Unless otherwise specified or shown, all motor starters will be furnished, installed and wired in conduit under this DIVISION 26 of this specification. All 120-volt power wiring for energy management systems and temperature control power source shall be furnished and installed under DIVISION 26 to a point (junction box or control cabinet as indicated) for connection by Control Installer. Verify requirements from Control Installer prior to bidding. Contractor shall install and connect all Variable Frequency drive equipment for Air Handler HVAC Equipment.

3.2 ADJUSTING, ALIGNING, AND TESTING:

A. All equipment furnished under this division shall be adjusted and tested by the Contractor. Motors and other equipment furnished by others, to which electrical connections are made under this division, shall be checked for short circuits and open circuits before energizing. Motors shall be checked for proper phasing and rotation. The thermal overload protection devices shall be checked in all motor starters, equipment, and all protection device size, motor nameplate full load amperage, and voltage rating for protection of the motor shall be listed (include equipment designation, rating of heater, motor nameplate horsepower, full load amps and voltage) and four copies of list shall be submitted to the Architect/Engineer.

B. Mechanism of all electrical equipment shall be checked, adjusted, and tested for proper operation. Protective devices and parts shall be checked and tested for specified and required application and adjusted as required. Adjustable parts of all lighting fixtures and electrical equipment shall be checked, tested, and adjusted as required to produce the intended performance.

C. Completed wiring systems shall be free from short circuits and after completion, perform tests for insulation resistance in accordance with the requirements of the National Electrical Code. All wiring systems shall be completely and totally “Safed” during construction. Only qualified personnel shall handle electrical systems.

3.3 ELECTRICAL CIRCUITRY FOR EQUIPMENT:

A. The electrical circuits, components, and controls for all equipment are selected and sized, based on the equipment specified. If substitutions and/or equivalent equipment are furnished, it shall be the responsibility of all parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the electrical characteristics and requirements of that furnished to that specified and/or shown. If greater capacity or more materials or labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then it shall be the responsibility of the parties involved in providing the substitute and/or equivalent items of equipment to provide all compensation for additional charges made for the proper rough-in, circuitry and connections for the equipment furnished. No additional charges above the Base Bid shall be allowed for such revisions.

B. Before rough-in of circuitry or connecting to equipment, furnished under this division, any other division, or by the Owner, the Contractor shall verify and coordinate the final electrical characteristics and requirements of the equipment being furnished and for that specified and shown on the drawings and provide for proper electrical rough-in and connection.

C. It shall be the Contractor's responsibility to verify exact requirements for equipment rough-in and connections of all equipment furnished by others including but not limited to Kitchen, Kitchen prep, coffee and snack areas, store areas, community rooms, hair salon and spa areas prior to installation. Extra costs will not be allowed for failure to verify rough-in and connection requirements before, after, and during installation.

3.4 EXCAVATION, CUTTING PATCHING:

A. All excavation and trenching shall conform to the requirements of the Florida Trench and Safety Act (90-96 Laws of Florida).

B. Excavation for Underground Electrical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10'; plus, a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

C. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1" in diameter and larger with emulsified asphalt tree paint.

D. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

E. Trenching: Excavate trenches for electrical installations as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6" to 9" clearance on both sides of raceways and equipment.
2. Excavate trenches to depth indicated or required.
3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6" of stone or gravel cushion between rock bearing surface and electrical installations.
5. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

F. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below.

1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For raceways less than 30" below surface of roadways, provide 4"-thick concrete base slab support. After installation of raceways, provide a 4"-thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
5. Other areas use excavated or borrowed materials.

G. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

H. For all such work employ competent workmen, and finish up in neat and workmanlike manner, equal in quality and appearance to adjacent work.

3.5 SUPPORTS AND SLEEVES:

A. The Contractor shall provide all inserts for the support of DIVISION 26 equipment to be placed in concrete or through concrete slabs as construction progresses. He shall provide all miscellaneous hanging and supporting hardware. All electrical work is to be concealed in or built into general construction shall be placed as construction progresses. Failure of the Contractor to coordinate work with other trades and the project construction progress shall make him responsible for all cost of cutting and patching, as required to install work. No structural member, masonry construction or finished work shall be cut or altered without prior written approval by the Architect/Engineer. Contractor shall fire rate all penetrations through all fire rated slabs or walls per the intended rating.

B. The Contractor shall supply and set into place all wall sleeves for conduits and ceiling inserts for hangers in areas of new construction as building construction progresses. Install equipment noted to be concealed in walls before walls are constructed in order that walls may be constructed around conduits, enclosures, etc. This shall include associated wall box hangers for Hollow core slabs as required for a complete and functional connection.

3.6 PROTECTION:

A. Metallic materials shall be protected against corrosion. Equipment enclosures shall be given rust-inhibiting treatment and standard finish by manufacturer. Aluminum shall not be used on contact with earth, and, where connected to dissimilar metal, shall be protected by suitable fittings and application treatment. All ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts, not of stainless steel or nonferrous materials, shall be hot-dipped galvanized.

B. The Contractor shall fully protect all finish parts of the materials and equipment against damage from whatever cause during the progress of the work until final completion. All materials and equipment in storage and during construction shall be covered in such a manner that no finished surfaces will be damaged or marred, and all moving parts shall be kept perfectly clean and dry.

C. All conduits stubbed out for future use shall have a pull wire installed; a plastic cap installed and be permanently identified as to the conduit origin.

D. No underground junction boxes shall be installed for any system type wiring, except for device floor boxes and exterior pull boxes, and secondary power pull boxes.

3.7 CLEARANCES:

A. The Contractor shall install all equipment so that all code-required and manufacturer-recommended servicing clearances are maintained. He shall be responsible for the proper arrangement and installation of all equipment within any designated space.

B. Should the Contractor determine that a departure from the contract drawings is necessary, he shall submit to the Architect/Engineer for approval detailed drawings of his proposed changes with his written reasons for the changes. No changes shall be implemented without the issuance of the required bulletin drawings, clarifications, and/or change orders.

3.8 CUTTING AND PATCHING:

A. The responsibility for any cutting of construction which is required for the installation of DIVISION 26 work shall be by the Contractor. The Contractor shall coordinate with all other Trades and the Owner before any cutting and obtain approval from the Architect/Engineer prior to any cutting. All patching and finishing shall be done by the Contractor.

B. Cutting shall be done with extreme care and in such a manner that the strength of the structure will not be endangered. Wherever possible, openings in concrete or masonry construction shall be by concrete saw or rotary core drill. Openings in any construction shall be cut the minimum size required for the installation of the work. Adequate protection shall be provided to prevent damage to adjacent areas and to prevent dust from spreading to adjacent areas.

C. Where openings or holes are cut in construction and the cutting breaks electrical circuitry or control circuitry conduit and wiring, then it shall be the responsibility of the Contractor to reroute the circuitry conduit and rewiring and to complete the circuitry as required and as approved by the Architect/Engineer. Temporary completion shall be provided where necessary before the permanent rerouting and completion work is finished.

D. Before any cutting, patching, or finishing work is started, dust and moisture protection shall first be installed as required and as specified in these specifications.

E. Openings cut in floor shall be cut by core drilling where possible. After work is installed through any opening in floor, the opening around the work shall be patched and sealed watertight and epoxy or silicone based, non-cracking elastomeric sealant and fire rated, as required.

3.9 RATED ASSEMBLY PENETRATIONS:

A. Any penetrations of fire or smoke rated assemblies made by this Contractor in vertical or horizontal construction shall be sealed and protected by this Contractor in order to maintain the established fire rating with methods as approved by the authority having jurisdiction. Contractor shall provide 120-volt power connections and fire alarm system interconnections for all Fire and Smoke dampers in all locations as required by the Mechanical drawings and all project drawings.

3.10 PAINTING:

A. Finish field painting is not included in this division.* (See SECTION, PAINTING.) All factory painted equipment shall be protected during construction. Contractor is responsible for painting conduits located above mesh ceiling areas.

3.11 IDENTIFICATION:

A. Identification nameplates shall be laminated plastic, secured to equipment with two stainless steel screws.

B. Each panelboard shall be equipped with a color-coded permanent plastic nameplate with 1/2" minimum letters, securely fastened to the device.

C. Each individually mounted circuit breaker, transfer switch, generator, disconnect switch, motor starter, dimming cabinet, relay cabinet, lighting contactor, transformer and/or any other control or protective device including equipment disconnect switches shall be equipped with a permanent color-coded plastic nameplate with 1/2" minimum letters.

D. Panelboards shall have correct and accurate typewritten directories. All circuits to be identified by devices served and room numbers (i.e., lighting Room 216). Handwritten directories will not be allowed.

E. All systems device outlet covers shall be color coded per the individual system color and shall have the panelboard and circuit number engraved into the cover of each outlet cover with black ink per the following:

1.	Life Safety electrical System	Yellow cover
2.	Critical electrical system	Orange cover
3.	Equipment electrical system	Green cover

F. Each junction box cabinet or wireway larger than 6" x 6" shall be equipped with a plastic color-coded nameplate with 1/2" minimum letters indicating the system enclosed.

G. All Systems junction boxes and outlet boxes shall be color coded inside and outside of the box prior to the installation of conductors per the following:

4.	Grounding System:	Green
5.	Fire Alarm System	Red
6.	Life Safety electrical System	Yellow
7.	Critical electrical system	Orange
8.	Equipment electrical system	Green

H. Entire box inside and out, including cover, shall be painted prior to installing conductors.

I. All Systems conduits shall be color coded with appropriate color-coded bands in order to identify the system installed per the following:

1.	Grounding System:	Green banding
2.	Fire Alarm System	Red banding
3.	Life Safety electrical System	Yellow banding
4.	Critical electrical system	Orange banding
5.	Equipment electrical system	Green banding

3.12 STORAGE OF MATERIALS:

A. Store all materials to prevent damage from rust, corrosion, physical injury, etc.

B. Keep site clean of accumulation of cartons, trash, debris, etc.

3.13 "AS-BUILT" DRAWINGS:

A. A set of DIVISION 26 drawings shall be kept on the job site on which all changes from the contract drawings are recorded, in red pencil, on a day-to-day basis.

3.14 OPERATIONS AND MAINTENANCE INSTRUCTION:

A. At the completion of the job, the Contractor shall turn over to the Architect/Engineer one set of marked "As-Built" drawings, plus three sets of all equipment catalog and maintenance data and three sets of shop drawings on all equipment. See paragraph "SHOP DRAWINGS" in this section. Contractor shall explain and demonstrate all systems to Owner's Representative.

3.15 ACCESS PANELS:

A. Access panels for DIVISION 26 equipment, devices, junction boxes, etc., shall be provided by this Contractor where building finishes do not allow access. This Contractor shall furnish and have installed appropriate access panels and, patch and paint all surfaces. This Contractor shall coordinate panel locations with the installing Contractor.

END OF SECTION 26 05 01

SECTION 26 05 02 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE:

A. This section outlines the intent of the plans and specifications of DIVISION 26 with regard to Basic Materials and Methods.

PART 2 - PRODUCTS

2.1 MATERIAL FURNISHED AS SPECIFIED:

A. Material proposed to be furnished as specified shall be in strict accordance with the drawings and specifications of DIVISION 26 and of the requirements of WCI. Shop drawings shall be furnished as required by SECTION 26 05 01 - ELECTRICAL SCOPE. All material furnished is subject to the approval of the Architect/Engineer and his authority for approval is final.

B. All electrical equipment shall be furnished with factory identification for the suitability of use and installation, either by a description marked on the equipment, permanently attached label, or printed description packed with the equipment, in accordance with Article 110 of the National Electrical Code (NEC). If a printed description is packaged with the equipment, this shall be bound in the Operation and Maintenance Manuals.

C. All material and equipment shall be new; shall be of the best quality and design; shall be free from defects and imperfections and shall have markings, or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size, and capacity. As possible, all material and equipment of the same type shall be of the same manufacturer. Equipment shall function and perform efficiently and quietly at the required capacity without producing objectionable noise within the occupied areas of the building; if not, the Contractor shall remedy the condition or replace the equipment at no additional cost to the Owner.

2.2 MATERIAL SUBSTITUTIONS:

A. No substitutions other than manufactures listed will be considered for this project.

PART 3 - EXECUTION

3.1 SAFETY:

A. Maximum consideration shall be given to job safety and only such methods as will reasonably insure the safety of all persons shall be employed. The codes and regulations of OSHA shall be given strict compliance as well as such other codes, laws, and regulations as may be applicable.

3.2 TECHNIQUE:

A. It is the intent of these plans and specifications to direct attention to the absolute necessity to use safe techniques and ones that provide quality installations in compliance with good practice and the plans and specifications of DIVISION 26.

3.3 PROTECTION:

A. Every precaution shall be taken during handling, installation, connection, transporting, erection, and performing any work to prevent and eliminate dust, debris, and moisture from entering or being carried into spaces outside the work area and onto or into the finished spaces. Cutting, patching, finishing, painting, or any other construction work which will cause dirt or dust to be created shall be separated from finished spaces by temporary dustproof partitions or curtains sealed at top, bottom, and all around.

END OF SECTION 26 05 02

SECTION 26 05 03 – TESTS AND VERIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified in this section.

1.02 DESCRIPTION

A. Time: Perform verification work as required to show that the System is operating correctly in accordance with contract documents and manufacturer's literature. All verification shall be done after 3-day full operational period.

B. Submission: Submit check out memos and completed testing results of all systems, cable, equipment, devices, etc., for acceptance prior to being energized or utilized.

1.03 QUALITY ASSURANCE

A. Compliance: Testing shall comply to the following standards;

1. NEMA
2. ASTM
3. NETA
4. ANSI C2
5. ICEA
6. NFPA

PART 2 - TESTS

2.01 EQUIPMENT

A. Instruments: Supply all instruments required to read and record data. Calibration date shall be submitted on test reports. All instruments shall be certified per NETA standards.

Adjustments: Adjust system to operate at the required performance levels and within all

tolerances as required by NETA Standards.

2.02 APPLICATIONS

A. Switchboards, Panelboards and Mechanical Equipment Feeders: After feeders are in place, but before being connected to devices and equipment, test for shorts, opens, and for intentional and unintentional grounds.

B. Cables 600 Volts or Less: Cables 600 volts or less in size #1/0 and larger shall be meggered using an industry approved "megger" with 1000V internal generating voltage. Readings shall be recorded and submitted to the Engineer for acceptance prior to energizing same. If values are less than recommended NETA values notify Engineer. Submit 5 copies of tabulated megger test values for all cables.

C. Ratings Above 600V: Cables above 600 volts in all sizes shall first be meggered, using an industry approved "megger" having 2500V internal generating voltage. When proper readings are obtained, the cables shall be "hy-potted" using (5) potentials and time periods as recommended by NETA, cable manufacturer for the type and voltage class of cables installed. Do not exceed (80%) of factory test voltage. Readings ("megger" and "Hy-pot") shall be recorded and submitted to the Engineer, for acceptance prior to energizing same. Submit 5 copies of tabulated megger test values for all cables.

D. Main circuit breakers and feeder circuit breakers 200 amps and greater shall be tested using primary injection testing as per NETA Specifications. Reports to include manufacturer's time current curve number and trip time. Submit five (5) copies to the Engineer at substantial completion.

E. Transformers (75) KVA and larger. Perform Insulation resistance test and turns ratio test. Submit five (5) copies to Engineer at substantial completion.

2.03 MOTORS

A. Procedure: Test run each motor, (5 HP) and larger. Tabulate and submit 5 copies of the Test Information at substantial completion for final inspection. Refer to form at the end of this Section.

B. Provisions: With the system energized, line-to-line voltage and line current measurements shall be made at the motors under full load conditions. The condition shall be corrected when measured values deviate plus or minus 10% from the nameplate ratings.

C. Insulation: Test the insulation resistances of all motor windings to ground with an appropriate test instrument as recommended by the motor manufacturer, before applying line voltage to the motors. If these values are less than the manufacturer's recommended values, notify the contractor providing the motor for correction before initial start up.

D. Power Factor: Check power factor of all motors (5 HP) and larger while driving its intended load, and at all operating speeds.

E. Electrode Ground: The resistance of electrodes (main service, generators, transformer, etc.) shall not exceed 5 ohms and shall be measured by The Contractor before equipment is placed in operation. Testing shall be performed on all grounding electrode installations. Testing shall be 2-point method in accordance with IEEE Standard 81. Submit all ground test readings to the Engineer in tabulated format at substantial completion.

2.04 EQUIPOTENTIAL GROUND

A. Equipotential Ground: Test all metal conductive surfaces likely to become energized within patient care areas. Test all large conductive surfaces likely to become energized within a volume defined as 6 foot from the patient bed horizontally or 7 foot 6 inches vertically.

1. Large metal surfaces not likely to be energized, which do not require testing:

a. Window frames

b. Door frames

c. Floor drains

d. Moveable metal cabinets

2. Test Method:

a. Use impedance and voltage measurements

b. Utilize established ground bus or ground bar in panel serving area.

c. Measure voltage from reference point to conductive surfaces and all receptacle ground contacts.

d. Measure impedance between reference point and receptacle ground contacts.

e. Check for proper polarity.

f. Identify the reference ground for each room on the ground test report. Provide a blue dot label with a permanent adhesive backing located on the bottom center of the reference ground outlet cover.

3. Maximum Acceptable Values:

a. Voltage: 20 mV plus or minus 20 percent

b. Impedance: 0.1 ohm plus or minus 20 percent

c. Quiet ground impedance: 0.2 ohm plus or minus 20 percent

4. Equipment:

a. Millivolt meter with 1 Kohm impedance and proper frequency response, in accordance with NFPA 99.

b. Polarity tester

5. Ground Test Report. Complete ground test report included at the end of this specification section and make available copies of such to engineer and inspecting authority at final inspection.

2.05 DRY TYPE TRANSFORMERS

A. Required Factory Tests: Required factory tests shall be as follows;

1. Ratio
2. Polarity
3. Losses:
   (1) No load
   (2) Full load
4. Resistance Measurements
5. Impedance
6. Temperature
7. Impulse Strength
8. Sound Level
9. Exciting Current
10. Low-frequency Dielectric Strength
11. ANSI Point and Curve

B. Submission: Submit test results with shop drawings.

2.06 EMERGENCY SYSTEM

A. General: Submit emergency system tests in accordance with NFPA 110. Refer to Specification Section 26 36 00 for additional testing information.

PART 3 - EXECUTION

3.01 SUBMITTALS

A. Equipotential Ground Test Report: Complete report form at the end of this specification.

B. Cable Test Report: Submit Cable Test Report in Triplicate.

C. Transformer Test Report: Indicate comparative data of ANSI and NEMA Standards. Indicate all characteristic values as specified herein. Certified copies of tests on electrically duplicate units are acceptable.

D. Check Out Memos: Complete all information on forms at the end of this specification, project information, and certificate of completed demonstration memo. Submit data for examination and acceptance prior to final inspection request.

E. Tabulated Data: Submit data on 8-1/2 x 11-inch sheets with names of the personnel who performed the test.

F. Final: Submit accepted memos before a request for final inspection.

3.02 QUANTITIES

A. Quantity: Submit 5 copies of the checkout memo on each major item of equipment. Insert accepted memos in each brochure with the performance verification information and submittal data.

FACILITY NAME:_____ PROJECT NAME:_____ AHCA LOG NO.

DATE: _____TESTED BY:

MAXIMUM TEST INTERVALS: NAME:

GENERAL CARE - 12 MOS.

CRITICAL CARE - 6 MOS. COMPANY:

WET LOCATIONS - 12 MOS.

GROUND TEST REPORT

TYPE METER USED AND EXTERNAL NETWORK IF USED:

_ NOTE: MAXIMUM READINGS PERMITTED - 20 MV NEW CONSTRUCTION

0.1 OHM NEW CONSTRUCTION

Room No.	AREA TYPE Description (C) = CRITICAL CARE AREA (G) = GENERAL CARE AREA	VOLTAGE MEASUREMENT			IMPEDANCE MEASUREMENT		REMARKS - IF VOLTAGE READINGS MORE THAN 20MV IN EXISTING CONST. NOTE TESTS & INVESTIGATION REQUIRED.
		NO. OF RECEPTS.	NO. OF OTHER	MAX. READING IN MILIVOLTS	NO. OF RECEPTS.	MAX READING IN OHMS	

PROJECT NAME:_____

MOTOR TEST INFORMATION

Name of Checker:_____

Date Checked:_____

(a) Name and identifying mark of motor _____

(b) Manufacturer _____

(c) Model Number _____

(d) Serial Number _____

(e) RPM _____

(f) Frame Size _____

(g) Code Letter _____

(h) Horsepower _____

(i) Nameplate Voltage and Phase _____

(j) Nameplate Amps _____

(k) Actual Voltage _____

(l) Actual Amps _____

(m) Starter Manufacturer _____

(n) Starter Size _____

(o) Heater Size, Catalog No. and Amp Rating _____

(p) Manufacturer of dual-element fuse _____

(q) Amp rating of fuse _____

(r) Power Factor at _____ Speed _____

(For variable speed motors provide

recording chart over operating range)

TABULATED DATA

VOLTAGE AND AMPERAGE READINGS

SWITCHGEAR OR PANELBOARD

FULL LOAD AMPERAGE READINGS:

DATE

TIME

PHASE A.

B.

C.

N.

FULL LOAD VOLTAGE READINGS:

DATE

TIME

PHASE A TO N _____ A TO B

B TO N _____ A TO C

C TO N _____ B TO C

NO LOAD VOLTAGE READINGS

DATE

TIME

PHASE A TO N _____ A TO B

B TO N _____ A TO C

C TO N _____ B TO C

_____ENGINEERS REPRESENTATIVE

_____CONTRACTORS REPRESENTATIVE

END OF SECTION 26 05 03

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SCOPE:

A. This section outlines the quality and type of conductors to be used in the various systems, locations and conditions.

PART 2 - PRODUCTS

2.1 WIRE AND CABLE 600 VOLT:

A. GENERAL:

Conductors shall have current carrying capacities as per NEC and with 600-volt insulation, #12 awg minimum for 20-amp circuits except for controls, and fixture wire. Conductors shall be copper, however feeders sized **larger than 100** amps may be Compact Aluminum type. Contractor to provide equal or larger conductor sizing/rating than the specified copper conductors

NOTE: Prior authorization from the Architect/Engineer if conductors are substituted to Compact Aluminum conductors rated above 100 amps. Conductors must have the equivalent or greater ampacity value than that of specified copper, shall physically fit below the connection lug and shall be submitted to the engineer for approval. All lugs shall be sized and rated for copper and aluminum conductors. Conductors shall be installed utilizing “no-lox” anti-oxidation compound and conductors shall be designated as “compact aluminum.”

B. GENERAL USE:

1. #12awg and #10awg shall be solid, type THWN/THHN insulation.

C. FEEDERS AND GENERAL USE:

1. #8awg and larger, and any size to motors shall be stranded type THWN.

D. FIXTURE WIRE:

1. Fixture wire shall be type THHN or XHHW may be used for all fixtures. Wire size shall be #12 AWG for fixtures up to 300 watts, #12 AWG for fixtures over 300 watts up to 1,500 watts and as required for fixtures over 1,500 watts. Fixture wire shall extend only from the fixture to the first junction box in conduit and not over 6' in length.

E. CONTROL WIRE:

1. Control wire shall be minimum #12 AWG copper, type THHN-THWN. Full color range as indicated for individual systems. See other sections of the specifications for requirements.

F. MANUFACTURER:

1. Wire and cable shall be as manufactured by Southwire Corporation or equal.

G. WIRE CONNECTIONS:

1. On wire larger than #10 shall be made with approved solderless connectors and covered with Scotch #33 electrical tape so that insulation is Owner approved equal to conductor insulation.

2. All connections and splices in exterior, handholes, pull/junction boxes, and underground locations shall be made watertight and waterproof.

H. #10 AND SMALLER COPPER CONNECTIONS:

1. Shall be made with T & B Sta-Kon wire joints, PT series, complete with insulating caps and installed with WT161 Tool or WT2000 Tool, Ideal Super-Nuts (not wire nuts), Ideal Wing Nuts, or Buchanan Elec. Products B Cap or Series 2000 Pres-Sure connectors complete with nylon snap-on insulators and installed with C24 pressure tool.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRE AND CABLE:

A. No conductor shall be smaller than #12 except where so designated on the drawings or hereinafter specified.

B. All conductors, wire, and cable shall be installed in conduit unless otherwise noted.

C. Multi-wire lighting branches shall be used as indicated.

D. All joints and splices in wire shall be made with approved solderless connectors, and covered so that insulation is Owner approved equal to conductor insulation. Splices shall not be permitted in control, security, fire alarm, television or communications systems, or where otherwise noted. Splicing of wire or cables will not be allowed below grade, including within boxes below grade.

E. No splices shall be pulled or installed into conduit.

F. Both conductors and conduits shall be continuous from outlet to outlet.

G. No conductor shall be pulled until conduit is cleaned of all foreign matter.

H. In installing the main electrical service, additional slack conductors shall be provided and terminated as required by electric utility for connection to utility equipment. Field coordinate with utility prior to installing conductors. Contractor shall provide all secondary connections to utility company transformer per utility company requirements. Provide all lugs, spade conductors, etc., per drawing and utility company requirements.

I. In installing parallel conductors, it is mandatory that all conductors making up the feeder be exactly the same length, the same size and the same type of conductor with the same insulation. Further, each group of conductors making up a phase or neutral must be bonded at both ends in an approved manner.

J. Conductor sizes indicated on circuit homeruns or in panelboard schedules shall be installed over the entire length of the circuit unless noted otherwise on the drawings.

K. Conductors shall be continuous and unspliced where installed in conduit. Splices shall occur only within wiring troughs, wireways, junction boxes, outlet boxes, or equipment enclosures where sufficient additional room is provided for all splices.

L. Provide isolated ground conductors per drawing requirements.

3.2 CIRCUITS AND BRANCH CIRCUITS:

A. Outlets shall be connected to branch circuits as indicated on drawings. No more outlets than are indicated shall be connected to a circuit.

3.3 WIRE AND CABLE DESIGNATION AND COLOR CODING:

A. Non-ferrous identifying tags or pressure sensitive labels shall be securely fastened to all cables, feeders, and power circuits in panels, starters, terminations of cables, etc. Tags or labels shall be stamped or printed to correspond with markings on drawings so that feeder or cable number and phase can be readily identified.

B. Each branch circuit and feeder conductor shall be color coded. All conductor sizes shall have a total impregnated insulation color as indicated below. Color code shall be strictly adhered to. Grounding conductors and grounded conductors shall have insulation color as indicated.

120/208 Volts	
Phase	Color
A	Black
B	Red
C	Blue
Neutral	White
Ground	Green

3.4 CONTROL CONDUCTORS:

A. Shall be color coded by use of color coded "tracers." No color circuit shall contain two identical conductors.

END OF SECTION 26 05 19

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SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE:

A. This section deals with the grounding of service equipment, transformers, and non-current carrying conductive surfaces of equipment, metal building, structures and other equipment.

B. All grounding connections shall be installed in accordance with the National Electrical Code and all local codes and requirements. Such codes shall be considered minimum requirements, and the installation of the grounding system shall insure freedom from dangerous shock exposure and shall provide a low impedance ground fault path to permit operation of overcurrent and ground fault protective devices.

PART 2 - PRODUCTS

2.1 CONDUCTORS:

A. All service and equipment grounding conductors, and bonding jumpers shall be insulated copper, type THHN, THWN, or THW conductors (unless noted otherwise) and shall be sized in accordance with the applicable portions of Articles 250 of the National Electrical Code. All Grounding conductors shall have total impregnated green color insulation.

2.2 GROUND RODS:

A. Ground rods shall be sectional 5/8" by 10', copper clad. All ground rods shall have a total 50'-0" length.

2.3 CONNECTIONS:

A. The Connection of a grounding conductor to ground rods shall be by Exothermic Welding.

B. Ground connections to building steel, equipment enclosures, equipment, and for all conductor's size #3 AWG and larger shall be bolted using T & B hydraulic compression type lugs, except all connections below grade and to ground bars shall be exothermic weld type.

C. Grounding conductor connections at conduit terminations shall be made by approved grounding bushings.

PART 3 - EXECUTION

3.1 MAIN SERVICE GROUNDING ELECTRODE SYSTEM:

A. The main service grounding electrode system shall consist of the following items bonded together by the grounding electrode conductors in accordance with NEC Article 250, Part H:

1. The main underground cold-water pipe, if metal, NEC 250
2. Metal frame of building where available, NEC 250
3. Concrete encased electrode, NEC 250
4. The building lightning protection system.
5. **Fire protection sprinkler piping, NEC 250.**

B. Driven ground rods spaced a minimum of 20' apart and connected parallel until resistance to ground does not exceed 5 ohms.

C. Main electrical panel at each building shall be grounded as indicated above. In addition, a grounding conductor shall be installed with the feeders and bonded to the main service grounding electrode system.

D. The neutral conductor shall be grounded at the service entrance main disconnect, and at each separately derived system only per NEC Article 250.

3.2 FEEDERS AND BRANCH CIRCUITS:

A. All feeders and branch circuits shall have installed in the same raceway as the circuit conductors, an insulated copper grounding conductor sized in accordance with Table 250 of the National Electrical Code unless such a grounding conductor is shown to be larger on the plans or specified to be larger elsewhere in these specifications.

3.3 EXPOSED NON-CURRENT CARRYING CONDUCTIVE SURFACES:

A. All exposed non/current carrying conductive surfaces of electrical equipment shall be grounded by a grounding conductor either run with the circuit conductors, and/or separate grounding conductors as shown.

3.4 OUTLET GROUNDING:

A. No electrical system neutral shall be used for an equipment ground.

B. All outlet boxes and junction boxes, lighting fixtures, convenience receptacles, switches, disconnects, etc. shall be grounded. The ground wire terminal of each convenience receptacle shall be connected to the grounding conductor. All motors, enclosures for electrical controls, all metal equipment supports for electrical controls and all similar items shall be connected to the grounding system.

C. All receptacles shall be grounded by connection to the equipment grounding conductor run with the circuit conductors. Isolated grounding conductors shall connect to the equipment device; equipment ground conductor shall connect to the device box.

3.5 SYSTEMS GROUNDING:

A. A #4 or larger as indicated insulated copper conductor installed in 3/4" concealed conduit (or as indicated on the drawings) shall be connected from the building grounding electrode system to each building mechanical EMS control cabinet, MDF and all IDF telephone terminal board, fire alarm cabinet, and security system cabinets. Terminate on an appropriately sized (8) terminal multi-conductor connection grounding lug located within cabinet or on terminal boards.

B. Provide copper ground bus as indicated. All connections shall be cadweld.

END OF SECTION 26 05 26

SECTION 26 05 33 - RACEWAYS - METAL

PART 1- GENERAL

1.1 SCOPE:

A. This section deals with the materials to be used as metal raceways, connections, and supports.

B. Minimum conduit size shall be 1/2” or unless otherwise noted.

PART 2 - PRODUCTS

2.1 CONDUIT - RIGID and E.M.T.:

A. Shall be galvanized outside and inside by hot dipping. E.M.T. shall be Electro-Galvanized. Conduits shall be as manufactured by Republic, Pittsburgh Standard, Wheatland, Triangle, Allied, or Youngstown.

2.2 COUPLINGS AND CONNECTORS RIGID AND I.M.C.:

A. Shall be standard threaded type, galvanized outside and inside by hot dipping. Threadless and clamp type not acceptable. Shall be as manufactured by Raco, Efcor, or Appleton.

2.3 COUPLINGS AND CONNECTORS - E.M.T.:

A. Shall be steel threaded compression type. All couplings and connectors shall be Efcor or Raco. Pressure indented type connectors or cast metal will not be approved for any location.

B. Connectors shall have plastic insulated throat inserts.

2.4 CONNECTORS - RAINTIGHT:

A. Shall be Meyers or Owner approved equal.

2.5 BUSHINGS:

A. Rigid, shall be threaded, insulated, malleable iron O.Z. type "B" or Efcor type 55. Grounding bushings shall be O.Z. type "LG" or Efcor type 56.

2.6 WATERTIGHT FLEX CONNECTORS:

A. Shall be Efcor, Raco, or Midwest Liquid Tite, with insulated throat.

2.7 CONDUIT CLAMPS AND SUPPORTS:

A. Shall be as manufactured by Efcor, Raco, Steel City, or G.A. Tinnerman.

2.8 CONDUIT FITTINGS:

A. Shall be manufactured by Pyle-National, Crouse-Hinds, Raco, Russell & Stoll, or Appleton.

PART 3 - EXECUTION

3.1 CONDUIT, TYPE OF INSTALLATION:

A. Two inches and smaller may be used where concealed in ceiling or walls, where there is no danger of mechanical injury. E.M.T. may be used where exposed 4' above floor for conduits 2" or smaller, unless otherwise noted.

B. Unless shown or specified otherwise, rigid galvanized or rigid schedule 40 pvc conduit shall be used as follows: (a) in floor slab, (b) for exterior use or other areas exposed to moisture, (c) where danger of mechanical injury exists, (d) through floor slab, (e) where E.M.T. or nonmetallic conduit is not specifically permitted per these specifications or NEC standards. All penetrations must be Fire sealed per the UL listing of the wall, floor or ceiling.

C. Liquid-tight flexible metal conduit shall be used for final connection to all motors, exterior HVAC units, transformers, all data equipment and all other rotating or vibrating equipment. Maximum length of 24".

D. Conduit installed below building footings and thru exterior walls shall be galvanized rigid steel.

E. Flexible metallic conduit raceways may be used to connect HVAC units located in interior mechanical areas. Minimum size 3/4".

3.2 INSTALLATION OF CONDUIT, E.M.T., RIGID:

A. Follow methods which are appropriate and approved for the location and conditions involved. Where not otherwise shown, specified, or approved in a particular case, run all wiring concealed.

B. Where rigid and aluminum conduits enter boxes they shall be secured in place by approved lock nuts each side and bushings.

C. Where E.M.T. enters boxes they shall be secured in place with approved threaded compression type fittings.

D. Conduit ends shall be carefully plugged during construction.

E. Use of running threads is absolutely prohibited. Conduit shall be jointed with approved conduit couplings. All couplings on I.M.C. and rigid conduit shall be threaded.

F. Before installing raceways for motors and fixed appliances, check locations of motor and/or appliance connections and locate and arrange raceways appropriately. Provide liquid tight flexible conduit connections to all motors, kitchen equipment, transformers, and/or any equipment which has moving or vibrating parts. Liquid tight flexible metal conduit shall generally not exceed 24" in length.

G. Exposed conduit runs shall be parallel and/or at right angles to building walls and/or partitions.

H. Where conduit crosses a structural expansion joint an approved conduit expansion fitting will be installed.

I. Fasten conduit securely in place by means of approved conduit clamps, hangers, supports, and fastenings. Arrangements and methods of fastening all conduit shall be subject to Architect/Engineer's direction and approval. Use only approved clamps on exposed conduit.

J. Apply two coats of asphaltum paint to all underground metallic conduit. Carefully retouch any breaks in paint and allow to dry before covering with earth. Leave exposed until after Architect/Engineer's inspection. Pittsburg Standard Rob-Kote may be used in lieu of painting.

K. Conduit shall be sized in accordance with the latest National Electrical Code except that no conduit shall be smaller than 1/2" unless otherwise noted. Conduit shall be sized larger than required above when so shown on the drawings or when required by local Code.

L. No conduit with an external diameter larger than 1/3 the thickness of the slab shall be placed in the slab. Conduits in slab shall not be spaced closer than 3 diameters on center.

M. All exposed conduit threads, metal supports, etc., exposed to elements or exterior of building shall be painted with rust preventive paint.

N. A 200 lb. test nylon pull cord shall be installed in all empty conduits.

O. All conduit connections to sheet metal cabinets or enclosures subject to the elements shall be terminated using raintight hubs.

P. Any conduit stubbed out for future shall be capped with a plastic cap and marked with a 2" minimum red metal tag which identifies conduit origin. Conduits stubbed up above grade or roof shall be tagged on the conduit. Conduit stubbed out below grade shall be tagged on nearest building wall, curb, etc., directly over the conduit run. All empty conduits shall have pull wires.

Q. Conductors shall not be installed in raceways until the raceway is completely installed, free of any foreign matter, and dried.

R. Install pull boxes in all runs having more than 270 degrees total bending (all directions combined and each complete offset counting as 90 degrees) or in runs more than 200' long.

S. Unless otherwise stated in these specifications or noted on the drawings, all raceway penetrations shall be made only at perpendicular angles to the penetrated surfaces. In no case shall conduit which is run along exterior walls penetrate insulation or vapor barriers.

T. Raceways not concealed in slabs or walls shall be securely anchored at regular intervals in accordance with NFPA 70 "NEC".

U. Use only galvanized pipe straps, wall brackets, or ceiling trapezes anchored with toggle bolts, expansion bolts, metal screws, or wood screws as appropriate. Provide all proper and listed structural hangers for electrical equipment connected to hollow core slabs.

V. Ceiling trapezes shall be supported by quarter-inch minimum diameter all-thread rods securely attached to the structure ceiling.

W. Raceways shall not be supported from the finished ceiling, mechanical duct work, piping, or from other equipment.

X. Straps and hangers shall be in accordance with the National Electrical Code and as recommended by the raceway manufacturer.

Y. Ceiling tie wire used to support conduit or devices is strictly prohibited.

Z. Install connectors and couplings per the requirements of the Manufacturer. Tighten to torque requirements.

AA. Conduits which extends through the roof-to-roof top equipment shall be galvanized rigid protected with a weatherproof and watertight pate roof boot. All penetrations through roof and pate roof boots shall be approved by the roof warranty guarantor and be accepted by the roof warranty guarantor prior to use. Written authorization by roofing company shall be provided during submittal phase.

BB. All Systems conduits shall be color coded with appropriate color-coded bands in order to identify the system installed per the following:

1.	Grounding System:	Green banding
2.	Fire Alarm System	Red banding
3.	Life Safety electrical System	Yellow banding
4.	Critical electrical system	Orange banding
5.	Equipment electrical system	Green banding

END OF SECTION 26 05 33

SECTION 26 05 34 - RACEWAYS - NON-METALLIC

PART 1 - GENERAL

1.1 SCOPE:

A. This section deals with the materials to be used as raceways where shown on the drawings or specified as non-metallic conduit.

1.2 WHERE USED:

A. Non-metallic conduit shall be used below grade only as permitted by the NEC, and as hereinafter specified, or as approved by the Owner's Authorized Representative. Conduit adapters shall be used in transition. Conduit system for grounding conductors only shall be PVC throughout without metallic components, as permitted by codes and standards.

PART 2 - PRODUCTS

2.1 SCHEDULE 40 RIGID PVC:

A. Conduit shall be composed of polyvinylchloride and shall be UL rated Type 40 for use with 90 C degree rated conductors. Conduit shall conform to NEMA standards and applicable sections of NEC.

B. Minimum size shall be 3/4"

2.2 FITTINGS:

A. All couplings, adapters, end bells, reducers, etc., shall be of same material and by the same manufacturer as conduit.

2.3 MANUFACTURER:

A. The conduit manufacturer shall have had a minimum of five years experience in the manufacture of the products. Non-metallic raceways shall be as manufactured by Carlon or Owner approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. All elbows, bends, etc., shall be either factory bends or made with an approved heat bender. Direct flame shall not be applied to conduit.

B. Installation of rigid non-metallic conduit shall comply with Article 347 of the National Electrical Code (NFPA 70) and these specifications.

C. Provide suitable expansion fittings as required on all raceways which are installed in walls subject to expansion and on raceways which penetrate expansion joints.

D. Provide a continuous, insulated, grounding conductor in every rigid, non-metallic raceway even if not shown on the drawings. The grounding conductor shall be connected to ground at each end of the raceway in accordance with Article 250 of the National Electrical Code (NFPA 70).

E. Where rigid non-metallic conduit transitions to metallic conduit, the location of the transition shall be underground.

F. All cuts shall be made with an approved saw and ends de-burred.

G. No PVC conduit shall be exposed to potential for damage.

H. All joints shall be made as follows: Clean the outside of the conduit to the depth of the socket, and the inside of the socket with an approved primer (colored purple) cleaner. Apply solvent cement to the interior of the socket and exterior of conduit, making sure to coat all surfaces to be joined. Insert conduit into the socket and rotate 1/4 to 1/2 turn and allow to dry.

I. Solvent cement shall be Rectorseal Gold #844 by the Rectorseal Corporation Meeting ASTM D2584.

J. Provide a continuous 6" wide, yellow plastic, underground utility marker tape above the full length of all underground conduits. Minimum depth 1'-0" below finished grade and 1'-0" above conduit.

K. In long sections of installed P.V.C. conduit, the Contractor shall use 90 degree elbow fittings in lieu of installing fabricated sweeps.

END OF SECTION 26 05 34

SECTION 26 05 35 BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE:

A. This section outlines the quality, type and installation of outlet boxes, junction boxes and gutters (wireways) for general and special use.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All boxes and fittings shall be labeled by Underwriters' Laboratories, Inc.

B. Interior outlet boxes shall be galvanized steel constructed with stamped knockouts in back and sides, and threaded holes with screws for securing box coverplates or wiring devices.

C. Weatherproof outlet boxes shall be corrosion-resistant cast type suited to each application and having threaded conduit ends, cast face plate with spring-hinged waterproof cap suitably configured, gasket, and corrosion-proof fasteners.

D. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, device rings, outlet boxes, and corrosion-resistant knockout closures compatible with outlet boxes being used and meeting requirements of individual wiring situations.

E. Pull boxes and junction boxes shall be constructed of code gauge galvanized sheet steel. Provide pull boxes with screw-on covers of the type and size to suit each respective location and installation. Boxes shall have continuously welded seams and shall be equipped with steel nuts, bolts, screws, and washers. Provide cast metal, gasketed type pull boxes for outdoor locations.

F. All boxes shall be sized as required by NFPA 70.

G. NOTE: PVC junction boxes are strictly prohibited.

2.2 OUTLET BOXES:

A. Shall be standard type, with knockouts, made of hot dipped galvanized steel as manufactured by Steel City, Raco or Appleton.

B. Ceiling outlet boxes shall be 4" octagon or square with plaster ring 1-1/2" deep or larger when required due to number of wires.

C. Boxes shall be provided with approved 3/8" fixture studs where required.

D. Except when located in exposed concrete block, switch and receptacle boxes shall be 4" square with plaster or masonry rings for single gang installation. Appropriate gang boxes shall be used for mounting ganged switches.

E. When installed in exposed concrete block, switch and receptacle boxes shall be masonry type stamped steel boxes.

2.3 JUNCTION BOXES AND PULL BOXES (INTERIOR):

A. Sheet Metal: Shall be standard NEMA 1 type with hinged lockable cover, with knockouts, made of hot dipped galvanized steel as manufactured by Steel City, Raco or Appleton.

B. Cast: Shall be type FS, FD, JB, GS, or SEH as required for application.

C. Mounting Panel: Provide removable plywood internal mounting panel for component installation.

2.4 JUNCTION AND PULL BOXES (EXTERIOR):

A. Shall be precast concrete for all below grade exterior use and where shown. All boxes installed above grade shall be NEMA 4x stainless steel weatherproof and watertight, or as indicated on the drawings.

B. Precast concrete below grade boxes located in exterior locations shall have 28-day concrete compressive strength = 4500 psi and be designed for H-20-44 loading. Install pull eyes and inserts for cable rack in two sides of box. Contractor shall install box at depth where top of box is 3 inches above final surrounding grade elevation. Provide beaded weld lettering on cover, indicating service enclosed IE “systems,” “power,” etc.

2.5 CABINETS:

A. Comply with UL 50, "Electrical Cabinets and Boxes" and NEMA ICS 6.

B. Construction: Sheet steel, NEMA 12 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24" apart, to hold fronts to cabinet boxes and provide for adjustment.

C. Provide flush or concealed door hinges not over 24" apart and not over 6" from top and bottom of door. For flush cabinets, make the front approximately 3/4" larger than the box all around. For surface mounted cabinets, make front same height and width as box.

D. Doors: Double doors for cabinets wider than 24".

E. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks shall be of a type to permit doors to latch closed without locking. All cabinets to be provided with locks.

F. Mounting Panel: Provide removable plywood internal mounting panel for equipment and component installation.

G. Provide color-coded identification nameplates for all junction boxes over 6" x 6” square per specification SECTION 26 05 01 - ELECTRICAL SCOPE.

H. Cabinets shall be Square D #24366, surface mounted with integral lockable cover and internal plywood backboard.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Comply with applicable portions of the National Electrical Contractor's Association's (NECA) "Standard of Installation".

B. Install all boxes and fittings in compliance with NFPA 70, the manufacturer's written instruction, and with recognized industry practices.

C. For locations exposed to weather or moisture (interior or exterior), provide weatherproof boxes and accessories.

D. Install pull boxes in all raceways runs having more than 270 degrees total bending (all directions combined and each complete offset counting as 90 degrees) or in runs more than 200' long.

E. Provide knockout closures to cap unused knockout holes where blanks have been removed and plugs for unused threaded hubs.

F. Boxes and conduit bodies shall be located so that all electrical wiring is accessible.

G. All boxes shall be sized per NEC.

H. Install pull boxes and wire troughs with front covers accessible per code requirements.

I. All flush floor outlets shall be leveled and flush with floor; shall be parallel and perpendicular to building construction lines and shall be compatible with floor material used. Verify exact location of floor boxes with Owner's Authorized Representative prior to concrete pour. Maintain fire rating through floor.

J. All recessed boxes shall be installed in a flush rigid manner with box lines at perpendicular and parallel angles to finished surfaces. Boxes shall be supported by appropriate hardware selected for the type of surface from which the box shall be supported. For example, provide metal screws for metal, wood screws for wood, and expansion devices for masonry or concrete.

K. The Contractor shall coordinate work with that of all trades so that each electrical box is the type suitable for the wall or ceiling construction provided.

L. Provide supporting channel and hardware as necessary to support boxes, enclosures, and cabinets.

3.2 INSTALLATION OF OUTLET BOXES:

A. Outlet boxes shall be securely fastened to structural members and shall not be supported by dry wall, gypsum board, plaster, etc. The device or plate installed in conjunction with the outlet box shall not be used for support.

B. Surface fixture outlet boxes shall be set so edge of cover comes flush with finished surface.

C. There shall be no more knockouts opened in any outlet box than are actually required.

D. Boxes shall be sealed during construction.

E. Back-to-back boxes shall be staggered at least 3" or as required by UL listing for rated walls.

F. Under no circumstances shall thru-the-wall boxes be used.

G. Outlet boxes two gangs and wider shall not be supported by attachment clips or any means which supports the box from less than two opposite sides. Such outlet boxes in stud walls shall be supported securely by support members spanning between studs.

3.3 INSTALLATION OF JUNCTION BOXES:

A. Provide junction or pull boxes where shown on the drawings and as required to facilitate installing conductors. Such boxes shall be "Code" sized unless required to be larger by the plans or other sections of this specification. All junction boxes shall be accessible.

B. Junction boxes shall be securely fastened to the building structure independent of ductwork, plumbing, etc. Junction boxes shall not be supported by conduit fittings.

C. Boxes to be embedded in concrete shall be properly leveled and anchored in place before the concrete is poured.

D. There shall be no more knockouts opened in any box than are actually required.

E. Boxes shall be properly protected during construction and shall be cleaned of all foreign matter before conductors are installed.

F. All junction boxes shall be located a minimum of 12” and maximum of 36” from ceiling grid. Overhead junction boxes may not be installed where accessibility is dependent on removal of a lighting fixture or access cover. No junction shall be located above drywall ceiling. All junction boxes’ locations shall be coordinated with all other trades such that all are accessible.

G. Wall mounted junction boxes and terminal cabinets shall be mounted at a maximum height of 60” AFF.

H. <u>All Systems junction boxes and outlet boxes shall be color coded inside and outside of the box prior to the installation of conductors per the following:</u>

1.	Grounding System:	Green
2.	Fire Alarm System	Red
3.	Life Safety electrical System	Yellow
4.	Critical electrical system	Orange
5.	Equipment electrical system	Green

3.4 INSTALLATION OF GUTTERS:

A. Conductors serving a wiring gutter shall be extended without reduction in size for the entire length of the gutter.

END OF SECTION 26 05 35

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL 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:

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.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 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

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. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.

2.2 ARMORED AND METAL-CLAD 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. Colors for Cables Carrying Circuits at 600 V and Less:

1. **Black letters on an orange field**.
2. Legend: Indicate voltage.

C. Colors for Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER HIGH VOLTAGE WIRING."

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) 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 conductor diameter such that the clear shield overlaps the entire printed legend.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.4 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2.5 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. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. 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 (915 MM)."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

C. 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 (10 mm).

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.8 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 (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F ((23 deg C)), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.9 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 (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-(100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. 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. Emergency Power.
2. Power.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, 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 conductors.

a. Color shall be factory applied.
b. Colors for 208/120-V 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. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) 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.

D. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels]with the conductor designation.

H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

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. Power transfer switches.
b. Controls with external control power connections.

M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer emergency operations>.

O. 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: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label 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 engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchgear.
   e. Switchboards.
   f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   g. Substations.
   h. Emergency system boxes and enclosures.
   i. Motor-control centers.
   j. Enclosed switches.
   k. Enclosed circuit breakers.
   l. Enclosed controllers.
   m. Variable-speed controllers.
   n. Push-button stations.
   o. Power transfer equipment.
   p. Contactors.
   q. Remote-controlled switches, dimmer modules, and control devices.
   r. Battery-inverter units.
   s. Battery racks.
   t. Power-generating units.
   u. Monitoring and control equipment.

END OF SECTION 26 05 53

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SECTION 26 05 72 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

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 a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
    b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Comply with IEEE 399 and IEEE 551.

B. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.

2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:

        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Control panels.
7. Standby generators and automatic transfer switches.
8. Branch circuit panelboards.
9. Disconnect switches.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 26 05 72

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SECTION 26 05 74 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, [provide software by the following] [provide software by one of the following:

1. ESA Inc.
2. Operation Technology, Inc.
3. Power Analytics, Corporation.
4. SKM Systems Analysis, Inc.

B. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings[and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article]. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.

4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.5 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 26 05 74

SECTION 26 09 23 - LIGHTING OCCUPANCY SENSORS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall box mounted, wall/corner mounted, and ceiling mounted occupancy sensors including dual technology, ultrasonic, and passive infrared technologies. This includes self contained PIR sensors as well as low voltage sensors that work with Switchpacks.

B. Related Sections:
   1. Section 260926 – Lighting Control Panels:] Lighting panels (switching) controlled by Central Dimming Control System.

1.2 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
   1. C62.41-1991 – Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits.

B. ASTM International (ASTM)
   1. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.

C. Canadian Standards Association (CSA).
   1. CSA C22.2 # 14 Industrial Control Equipment
   2. CSA C22.2 # 184 Solid-State Lighting Controls
   3. CSA C22.2 # 156 Solid-State Speed Controls

D. International Electrotechnical Commission .
   1. (IEC) 801-2 Electrostatic Discharge Testing Standard.
   2. IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.

E. International Organization for Standardization (ISO)
   1. 9001:2000 – Quality Management Systems.

F. National Electrical Manufacturers Association (NEMA)
   1. WD1 (R2005) - General Color Requirements for Wiring Devices.

G. Norma Official Mexicana (NOM).
   1. NOM-003-SCFI Productos eléctricos - Especificaciones de seguridad (Electrical products - Safety Specifications)

H. Underwriters Laboratories, Inc. (UL):
   1. 94 – Flammability Rating
   2. 916 – Energy Management Equipment.

3. 508 (2005) - Standard for Industrial Control Equipment.
4. 244A – Appliance Controls
5. 935 (2005) - Fluorescent Ballasts

1.3 SYSTEM DESCRIPTION

A. Permanently installed
   1. Wall switch occupancy sensors
   2. Ceiling mounted occupancy sensors
   3. Switchpacks

1.4 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Specification Conformance Document: Indicate whether the submitted equipment:
   1. Meets specification exactly as stated.
   2. Meets specification via an alternate means and indicate the specific methodology used.

C. Shop Drawings; include:
   1. Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.
   2. Schematic of system.
   3. Lighting plan clearly marking product type, location and orientation of each sensor.

D. Product Data: Catalog specification sheets with performance specifications demonstrating compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer: Minimum 20 years’ experience in manufacture of occupancy sensor lighting controls.

B. Manufacturer’s Quality System: Registered to ISO 9001:2000 Quality Standards, including in-house engineering for product design activities.

C. Occupancy Sensing Lighting Controls:
   1. Listed by [CSA] [NOM] [UL] specifically for the required loads. Provide evidence of compliance upon request.

D. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.

E. Source Limitations: To assure compatibility, obtain occupancy sensors from a single source with complete responsibility over all lighting controls, including accessory products. The use of subcontracted component assemblers is not acceptable.

1.6 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive

equipment:

1. Ambient temperature: 0° to 40° C (32° to 104° F).
2. Relative humidity: Maximum 90 percent, non-condensing.
3. Occupancy Sensors must be protected from dust during installation.

1.7 WARRANTY

A. Provide manufacturer's 5-year parts warranty.

1.8 MAINTENANCE

A. Make ordering of new equipment for expansions, replacements, and spare parts available to end user.
B. Make new replacement parts available for minimum of ten years from date of manufacture.
C. Provide factory direct technical support.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Eaton Lighting Systems

B. Substitutions:
   1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders.
   2. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
   3. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.
   4. Provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 SENSOR PERFORMANCE REQUIREMENTS

A. Sensing mechanism:
   1. Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   2. Ultrasonic:
      a. Utilize an operating frequency of 32 kHz or 40 kHz that shall be crystal controlled to operate within plus or minus 0.005% tolerance.
      b. Utilize Doppler shift ultrasonic detection technology.
   3. Dual technology:
      a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
      b. Utilize an operating frequency of 32 kHz or 40 kHz that shall be crystal controlled to operate within plus or minus 0.005% tolerance.
      c. Incorporate Doppler shift ultrasonic and passive infrared motion detection technologies. Products that react to noise or ambient sound shall not be considered.

B. Power failure memory:
   1. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.

C. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

D. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards.

E. Sensor shall have time delays from 10 to 30 min.

F. When specified, sensors shall automatically adjust time delay and sensitivity settings.

G. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

H. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

I. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

2.3 LINE VOLTAGE CEILING MOUNTED OCCUPANCY SENSORS

A. Product: OAC-DT-2000-

B. Provide all necessary mounting hardware and instructions.

C. [Provide a recessed bypass manual "override on" key on each sensor.]

D. Provide a mechanical air-gap on/off function for all sensors.

E. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet

F. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.

G. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.

H. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor’s longevity.

I. Shall have no leakage current to load, in manual or in Auto/Off Mode for safety purposes and shall have voltage drop protection.

J. Where specified, sensors shall offer daylighting foot-candle adjustment control and be able to accommodate dual level lighting.

K. Where specified, dual relay sensors shall offer daylighting foot-candle adjustment control for either or both relays.

L. Where specified, dual relay sensors shall offer a Bathroom Mode which keeps the second relay ON for an addition 8 minutes after the first relay has been turned off.

M. Where specified, sensor packaging shall be 100% recycled [made entirely from post-consumer waste (100% post-consumer fiber content) as well as, 100% recyclable].

N. Sensors shall be RoHS compliant

O. Where specified, sensors shall offer integral Bi-level Automatic On (just one lighting level comes on automatically when occupancy is detected)

2.4 WALL / CORNER MOUNTED SENSORS

A. Product: OAWC-P-120W

B. Provide all necessary mounting hardware and instructions.

C. Sensors shall be Class 2 devices.

D. Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

E. Where specified, sensors shall offer daylighting footcandle adjustment control

F. Where specified, sensor packaging shall be 100% recycled [made entirely from post consumer waste (100% post consumer fiber content) as well as, 100% recyclable].

G. Sensors shall be RoHS compliant.

H. Where specified, sensors shall offer integral Bi-level Automatic On (just one lighting level comes on automatically when occupancy is detected)

2.5 OCCUPANCY WALL SWITCHES

A. Product: [OSW-P-0451-MV

B. Provide vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0 mm thickness.]

C. Provide a recessed bypass manual "override on" key on each sensor.

D. Provide a mechanical air-gap on/off function for all sensors.

E. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet

F. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.

G. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.

H. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

I. Shall have no leakage current to load, in manual or in Auto/Off Mode for safety purposes and shall have voltage drop protection.

J. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from Automatic On to Manual On.

K. Where specified, sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

L. Where specified, dual relay sensors shall offer daylighting footcandle adjustment control for either or both relays.

M. Where specified, dual relay sensors shall offer a Bathroom Mode which keeps the second relay On for an addition 8 minutes after the first relay has been turned off.

N. Where specified, sensors shall feature a universally recognized light bulb icon for end user ease of identification of use.

O. Where specified, dual relay sensors shall feature universally recognized light bulb and fan icons for end user ease of identification of use.

P. Where specified, sensor packaging shall be 100% recycled [made entirely from post consumer waste (100% post consumer fiber content) as well as, 100% recyclable].

Q. Sensors shall be RoHS compliant.

R. Where specified, sensors shall have an EcoMeter that provides a visual indicator of energy usage, increasing end user awareness and reminding individuals to take control of their lighting to maximize energy savings.

S. Where specified, low voltage sensors shall have a Tracking/HVAC Mode that allows the load connected to the Form C BAS relay to remain on when the lights are turned off manually.

T. Where specified, sensors shall have a tamper-proof Automatic Only Mode that automatically turns lighting on and off without requiring a user to push a button.

2.6 SENSOR SWITCHPACKS

A. Product: SP20-MV

B. Plenum rated

C. Control wiring between sensors and control units shall be Class 2, 18-24 AWG, stranded U.L. Classified, TEFLON jacketed cable suitable for use in plenums.

D. Integrated, self-contained unit consisting internally of an isolated load switching control relay [and a power supply to provide low voltage power].

E. Shall be compatible with incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.

F. Shall be capable of controlling receptacle or plug loads. [SPRC-R-20-120], [SP-R-20-120]

2.7 SOURCE QUALITY CONTROL

A. Perform full-function testing on 100% of all system components and panel assemblies at the factory.

PART 3- EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer’s installation instructions.
B. Provide complete installation of system in accordance with Contract Documents.

C. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

3.2 TESTING

A. Upon completion of all wiring and after all fixtures are installed and lamped, a representative shall check the installation prior to energizing the system. Each installed occupancy sensor shall be tested in the Test Mode to see that lights turn OFF and on based on occupancy.

B. At the time testing, the owner’s representative shall be thoroughly instructed in the proper operation of the system.

END OF SECTION 26 09 23

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SECTION 26 24 13 - DISTRIBUTION SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified of this section.

1.2 DESCRIPTION

A. Description of System: Provide factory-assembled, metal-enclosed switchboard for service entrance from line terminals to outgoing feeder terminals, complete, installed, and tested in place.

B. Description of System: Provide factory-assembled, metal-enclosed switchboard for distribution and control of power from line terminals to outgoing feeder terminals, complete, installed, and tested in place.

C. General: Switchboard shall include all main and branch protective devices, related equipment as required or as listed on drawings, with all necessary interconnections, instrumentation, control wiring, etc.

1.3 DISTRIBUTION SWITCHBOARDS QUALITY ASSURANCE

A. ANSI: The latest edition of the Reference Standards for the American National Standards Institute shall apply as follows;

1. ANSI Y32.2 - Graphic Symbols for Electrical and Electronic Diagrams.
2. ANSI Z55.1 - (R1973) Gray finishes for Industrial Apparatus and Equipment.
3. ANSI C57.13 - Instrument Transformers

B. NEMA: National Electrical Manufacturers Association shall apply as follows;

1. NEMA PB2, Dead front Switchboards.
2. NEMA AB1, for molded case circuit breakers and switches.
3. NEMA MS1 for enclosed switches.

C. NFPA: The latest edition of the National Fire Protection Association shall apply as follows;

1. NFPA 70, National Electrical Code (NEC).
2. Refer to Section 26 05 00 for additional references.

D. UL: The latest edition of the Underwriters' Laboratories, Incorporated shall apply as follows:

1. UL Electrical Construction Materials List Switchboards-dead front type (384 W4) WEVZ.

2. UL 891-Dead front switchboards.

3. UL 50 Cabinets and boxes.

4. UL 38 Enclosed and dead front switches.

5. UL 489 Molded case circuit breakers.

6. UL 891 Dead front switchboards.

7. UL 943 Ground fault circuit interrupters.

E. Source Quality Control: Tests to meet NEMA PB2 requirements.

F. Design Tests: Rated Continuous current test, short circuit current test, Enclosure test, Dielectric test.

G. Production Tests: Perform tests on completed switchboard assembly.

H. Type: Dielectric tests, Mechanical operation test, Grounding tests, Control wiring tests, Electrical operation tests.

1.4 SUBMITTALS - DISTRIBUTION SWITCHBOARDS

A. General: Submit layouts showing concrete pad dimensions, conduit entrance and available space, bus duct connections, electrical rating, nameplate nomenclature, single-line diagram (in accordance with ANSI Y32.2) indicating all connections and control.

B. Shop Drawings: Shop Drawings shall be submitted for each switchboard and shall clearly indicate all of the following information;

1. Enclosure elevations, studs and details.

2. Complete Construction Information

3. U.L. Label

4. Each overcurrent device amperage rating, circuit number and position/location in the switchboard.

5. Electrical characteristics

6. Dimensions, (width, depth, height, weight)

7. Switchboard classification

8. Frame size, rating and interrupting capacity of each breaker, and of total assembly.
9. Horsepower rating at rated voltage of fused switches and/or breakers.

10. Size and type of fuses being provided.

11. Ranges of all meters.

12. Type of labeling for each overcurrent device and load (Provide at least one sample with shop drawing).

13. Main switchboard Plastic Laminate nameplate indicating project name; Architect, Engineer and Contractor.

14. Product data for switchboard mounted transformers; transfer switches; main fused, power breaker; or other specialties clearly and/or separately called out in the contract documents.

15. Bus bar size, type arrangement and spacing (Phase, neutral and ground bar).

16. Transparency log paper time current curves for protective relays, current and potential transformer excitation and saturation curves, and fuses.

17. Protective relay instruction books.

18. Shipping sections.

19. Lug sizes for cables on all switches or breakers.

20. Incoming lug sizes.

C. Product Data: Manufacturer's written recommendations for storage, protection, handling, installation instructions and field test requirements. Record all field tests, itemize data and submit at end of project with project manual.

D. Test Reports: Reports of production and field tests.

E. Operations and Maintenance Data: Provide and comply with manufacturer's instructions for tightening bus connections, performing cleaning, operating and maintaining switchboard.

1.5 QUALITY ASSURANCE

A Standards: The switchboard shall comply with the latest edition of the following standards:

1. American National Standards Institute (ANSI):

   a. ANSI Y32.2, Graphic Symbols for Electrical and Electronic Diagrams.
   b. ANSI Z55.1 (R1973) Gray Finishes for Industrial Apparatus and Equipment.

2. National Electrical Manufacturers Association (NEMA) PB2 - Tests.

3. National Fire Protection Association (NFPA).

   a. NFPA 70-1993, National Electric Code (NEC).

4. Underwriters Laboratories (UL)

   a. (384 W4) WEVZ Switchboards
   b. 891 Dead Front Switchboards

B. Source Quality Control:

1. Design Tests:

   a. Rated Continuous current test.
   b. Short circuit current test.
   c. Enclosure test.
   d. Dielectric test.

2. Production Tests:

   a. Perform tests on completed switchboard assembly.

   b. Type:

      1) Dielectric tests.
      2) Mechanical operation test.
      3) Grounding tests.
      4) Control wiring tests.
      5) Electrical operation tests.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handling: Only lift switchboard using eyes, yokes, and skids provided by manufacturer.

B. Storage: Do not store indoor switchboard exposed to weather.

C. Protection: Physically protect switchboard against all damage. Cover switchboard with suitable material to avoid damage to finish.

1.7 ACCEPTABLE MANUFACTURERS

A. The basis of design is ITE Siemens

B. Acceptable Manufacturers: Acceptable manufacturers shall be Square D, or equal in Eaton.

PART 2 - PRODUCTS

2.1 DISTRIBUTION SWITCHBOARDS

A. General: Switchboards shall be dead front with front accessibility required. The switchboard frame shall be of formed code gauge steel rigidly bolted together to support all cover plates, bussing and component devices during shipment and installation. Steel base channels shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting. Each switchboard section shall have an open bottom and an individually removable top plate for installation and termination of conduit. All front covers shall be screwed on and removable and all doors shall be hinged with removable hinge pins. Top and bottom conduit areas shall be clearly indicated on shop drawings. Switchboards shall be freestanding and completely self-supporting structures, 90" high.

2.2 FINISH

A. Preparation: All steel surfaces shall be chemically cleaned and treated to provide a bond between paint and metal surfaces to help prevent the entrance of moisture and formation of rust under the paint film.

B. Color: The switchboard exterior shall be finished in indoor light gray No. 61, ANSI Z55.1.

C. Coating: Apply corrosion-protective undercoating and allow to dry prior to final coat. Touch up any scratches prior to calling for final inspection.

2.3 BUSSING AND TERMINATIONS

A. Bus bars: Buses shall be plated copper or Aluminum sized on the basis of not more than 800 ampere per square inch current density. Bussing shall be of sufficient cross-sectional area to meet UL Standard 891 temperature rise. The bus structure shall be braced and rated to withstand mechanical forces exerted during short circuit current conditions when connected directly to a power source having a minimum 65,000 rms symmetrical amperes. A ground bus shall be provided, and factory secured to each vertical section of switchboard.

B. Bus Supports: All bus supports, connections and joints shall be bolted with hex-head bolts and Belleville washers to minimize maintenance requirements.

C. Accessibility: Bus connections shall be front accessible. Each switchboard end section shall include all provisions for the addition of future sections.

D. Space Provisions: Where space for future is called for on drawings, provide all necessary hardware and bus, except device connecting straps.

E. Ratings: Switchboard through bus shall have continuous current rating of 100% of main device frame size.

F. Terminations: All line and load termination points shall be suitable for the quantity and size of terminated conductors as indicated on the drawings and shall be suitable for each type of conductor material. Terminations shall be front accessible.

G. Hardware: All hardware shall be manufactured from high tensile strength steel and have a suitable protective finish.

H. All Main Circuit breakers and distribution circuit breakers located within the Switchboard shall be 100 % rated.

I. Provide internal ARC REDUCTION SWITCH (ARS)

2.4 ACCESSORIES

A. General: Switchboard shall be provided with adequate lifting means from the factory and shall be capable of being rolled or moved into installation position and bolted directly to its concrete base (housekeeping pad) without the use of floor sills.

B. Provide main circuit breaker with complete internal circuit monitor system, Square D PM870 or equal.

C. Provide Kirk key interlock as indicated.

2.5 CONTROL POWER AND WIRING

A. General: Where electrically operated devices or ground fault relays requiring external power are indicated, provide 120-V control circuits supplied through secondary disconnect devices from internal control power transformer.

B. Control Power Fuses: Include primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. All control wiring conductors shall have heat shrink identification labels on each end of termination. Terminations shall be made to screw terminal strips using accepted conductor terminals. All points of terminal strips shall be labeled to match conductor labeling.

2.6 MAIN SECTION

A. General: The service disconnect device shall be as specified herein and shall be totally front accessible and front connectable. Main device shall be provided with ground fault protection and shunt trip. Main circuit breaker shall be solid-state with adjustable settings for long-time, short time, instantaneous, long-time delay and short time delay.

B. Ground Fault Protection: Ground fault protection system shall be provided consisting of the following;

1. A ground sensor on line side of main switch encircling all phase and neutral conductors connected to an adjustable solid state ground relay switch which initiates automatic shunt tripping of the main and/or branch circuit interrupting devices.

2. System shall be adjustable from 200 to 1200 primary amperes, and time current characteristics shall provide 6 cycle operation at about ten times setting.

3. Relay output shall operate at 120 volts A.C. fused source from main bus. Provide all terminal blocks, transformer, auto-reset fuses, interconnecting wiring, etc.

4. Submit relay curves and all main/branch breakers for coordination study.

2.7 AUXILLIARY SECTION

A. Provide matching auxiliary section for the switchboard for wire access to secondary conductors, as required and as physical space allows.

PART 3 - EXECUTION

3.1 INSPECTION

A. Preparation: Examine area to receive switchboard to assure that there is adequate clearance to meet NEC requirements and normal maintenance issues for switchboard installation. Check that housekeeping pads (concrete base) are level and free of irregularities. Start work only after any unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Compliance: Provide switchboard complete in accordance with manufacturer's written instructions, NEC, and all applicable codes. Provide code required clearance for access and maintenance. The area required for the installation of the switchboard is limited, insure all equipment will physically fit within allocated space prior to ordering switchboard.

B. Mounting: Mount switchboard on 4" high housekeeping pad (concrete base). Pad shall extend 4" beyond switchboard edge on all sides with all equipment installed.

3.3 FIELD QUALITY CONTROL

A. General: Provide field tests prior to energization as follows;

1. Megger check and record all data, of phase to phase and phase to ground insulation levels.

2. Continuity.

3. Short Circuit.

4. Proper phase relationship.

B. Provisions: Perform tests according to switchboard manufacturer's instructions.

3.4 ADJUSTMENT AND CLEANING

A. Adjustments: Adjust operating mechanisms for free mechanical movement.

B. Connections: Tighten bus connections and mechanical fasteners.

C. Finish: Touch-up scratched or marred surfaces to match original finish.

END OF SECTION 26 24 13

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE:

A. This section outlines the requirements for panelboards.

B. The basis of design is ITE Siemens

C. Acceptable Manufacturers: Acceptable manufacturers shall be Square D, or equal in Eaton or Siemens.

PART 2 - PRODUCTS

2.1 PANELBOARDS:

A. Panelboards shall be dead front type and shall be in accordance with Underwriters' Laboratories, Inc., standard for panelboards and enclosing cabinets and so labeled.

2.2 PANELBOARD BOXES:

A. Panelboard boxes shall be fabricated from sheet steel. A metal framed circuit directory card holder with clear plastic covering shall be welded on the inside of door. Panelboards shall be for surface mounting unless otherwise noted on the drawings.

B. Ampacity and service voltage of main bus, lugs or main breakers and branch circuit breakers shall be as indicated in schedules. Entire panelboard shall be capable of withstanding a short circuit not less than the interrupting capacity of any breaker in the panel. Bus connectors shall be for distributed phase arrangement and shall be copper or aluminum. Bussing shall be copper or aluminum.

C. All flush mounted Panelboards shall have (4) 1” spare concealed conduits stubbed into the accessible ceiling adjacent to the Panel board for future Panel access.

2.3 GROUND BUS:

A. Full Size copper ground bus shall be furnished in all panelboards.

B. Provide Isolated ground bus where indicated on the drawings

2.4 NEUTRAL BUS:

A. Full size copper neutral bus shall be furnished.

2.5 MAIN LUGS:

A. Main lugs shall be rated for copper conductors and sized for conductors as shown.

2.6 MAIN BREAKERS:

A. Main breakers shall be provided as called for on the drawings.

B. Main breakers and or branch circuit breakers shall be shunt trip type where called for on the drawings or as required by Code.

2.7 ASSEMBLY:

A. Panelboards shall be factory assembled with branch breakers arranged as shown in schedules. Breakers shall be numbered vertically beginning top left. Breaker numbers shall be permanently attached to trim. Panel shall be minimum 20" wide, unless specifically noted otherwise.

2.8 CIRCUIT BREAKERS:

A. Circuit breakers shall be bolt-on, quick break, quick make, thermal-magnetic type, for alternating current. Breakers shall trip free of the handle and tripping shall be indicated by the handle assuming a position between OFF and ON. Multi-pole breakers shall be internal common trip (handle ties are not permitted). Provide trip, frame, poles, and voltage rated circuit breakers as indicated on drawings. Circuit breakers serving air conditioning and refrigeration equipment shall be HACR rated from the factory by the manufacturer.

2.9 SPECIAL REQUIREMENTS:

A. Any special requirements on the drawings or schedules, such as ground fault protection, circuit breakers, combination arc fault type circuit breakers, increased interrupting capacity, arc fault circuit breakers ,shunt trip type circuit breakers, feed thru panel boards, isolated ground bus, Nema 4x enclosures etc., shall supersede these specifications, but only insofar as that particular requirement is concerned and as indicated.

PART 3 - EXECUTION

A. All panelboard dimensions shall be carefully checked and coordinated with the proper trades and allocated physical space to insure proper mounting space, support and required code clearance.

B. Wiring in panelboard gutters shall be done in a neat and workmanlike manner. Wiring shall be grouped into neat bundles and secured with nylon 600v rated tie wraps within all panel boards.

C. All lugs shall be properly sized for the conductor type and size and shall be torqued as recommended by the manufacturer.

D. Provide plastic panel board identification nameplate on cover for each panelboard indicating panelboard name and voltage.

E. Provide type written directories for each panelboard indicating the exact load and the location of the load served…I.E…room number etc…

F. Load center construction shall not be utilized.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE:

A. This section outlines the quality and requirements of the basic devices, switches, receptacles, etc., to be used and the installation instructions for the devices.

PART 2 - PRODUCTS

2.1 WIRING DEVICES:

A. Switches and receptacles shall be A.C. type of the kind indicated.

B. Switches shall be specification grade silent operation toggle, rated for use at 20 amps, 120-277 volts AC.

2.2 SCHEDULE:

	Acceptable Manufacturers		
Switch Type	Hubbell #	Arrow-Hart #	Bryant #
20A SPST	1221	1991	4901
20A 3-way	1223	1993	4903

A. Receptacles shall be specification grade and shall be provided in duplex arrangement unless otherwise noted.

	Acceptable Manufacturers		
Receptacle Type	Hubbell #	Arrow-Hart #	Bryant #
20A Duplex 2P, 3W 125V, NEMA 5-20	5362	5362-S	5362
20A Duplex xP 3W 125V NEMA 5-20 Isolated Grounding Type	IG5362	IG5362	IG5362
Ground Fault Circuit Interrupters	GF-5362	GF-5362	2091S

B. Provide 20amp 125vac Hospital Specification Grade wiring devices where indicated on the drawings.

C. Weatherproof receptacles shall be GFCI types with gasketed key lockable flip cover type cover plates. Cover plates shall be Pass & Seymour #WP-26 stainless steel. Surge suppression type outlets shall be Hubbell #83625 (blue) or equal.

D. Receptacles provided for attachment of cord and plug equipment shall be heavy duty, specification grade, non-interchangeable, flush mounted types of the proper NEMA configuration to serve the equipment. Device NEMA configurations shall be verified prior to installation of circuit conductors. Provide strict coordination with the Kitchen equipment installer in order to provide all required

power outlets and final connections. Contractor shall provide all wiring harness “pigtails” for all equipment connections.

2.3 PLATES AND ACCESSORIES:

A. All devices shall have proper plates, carpet flanges, trim, etc., as manufactured by same manufacturer as devices. Any telephone or other outlet which is not equipped with a plate furnished by others shall have one provided by this Contractor. Device plates shall be color and type as shown below.

B. All Public Finished and back of house spaces:

1. Grey Devices
2. Stainless Steel Plates

C. Patient care areas and residence rooms: (See 3.1 D)

3. White Devices
4. White matching Nylon engraved Plates

D. Surface mounted devices in unfinished areas shall have galvanized plate with rounded edges.

PART 3- EXECUTION

3.1 INSTALLATION:

A. All devices shall be installed so that only one wire is connected to each terminal.

B. Install all components in accordance with the manufacturer's written instructions, NECA's "Standard of Installation", the applicable requirements of the National Electrical Code, and recognized industry practice.

C. Coordinate location of boxes prior to rough in with mill work cabinets, built-ins, marker and tack board and all other trades.

D. <u>All Systems Devices, junction boxes and outlet boxes shall be color coded inside and outside of the box as well as the device prior to the installation of conductors per the following:</u>

1. Grounding System: Green
2. Fire Alarm System Red
3. Life Safety electrical System Yellow
4. Critical electrical system Orange
5. Equipment electrical system Green

3.2 MOUNTING HEIGHTS:

A. Mounting heights are approximate. The exact locations and mounting heights of all devices shall be determined with coordination with all millwork drawings and on-site conditions. It shall be the Contractor's responsibility to coordinate with all trades to insure the correct installation, i.e., over counters in or above back-splashes, within block walls, tile, and other specific construction features. Location of outlets mounted in built-ins, millwork, and cabinetry shall be verified. Outlets mounted in kick or toe spaces shall be mounted horizontally. Outlet boxes shall be mounted to prevent device plate from overlapping backsplash, trim, tile, etc. Locate so device plate will lay flat against surface completely around the perimeter of plate.

B. Outlets, other than those coordinated with counter tops, shelves, and cabinets, shall be located with the center line of outlet boxes the following distance above the finished floor, unless otherwise indicated:

1. Receptacles, General: 1'-6"
2. Telephone Outlets: 1'-6"
3. Switches, General: 4'-0"

C. All device mounting heights shall be in accordance with requirements for making buildings accessible to the handicapped. (ADA)

3.3 GENERAL MOUNTING:

A. Verify all door swings with the Architectural drawings. Locate boxes for light switches within 4" of door trim. Where switches are shown on the drawing grouped together they shall be installed under a single plate. Where required, barriers shall be provided in the outlet boxes.

B. Where receptacles, telephone outlets, computer outlets, TV outlets and auxiliary system outlets are shown on the drawings grouped together they shall be installed with a new maximum of 4" between outlets. Coordinate to actual dimensions in the field.

C. Devices and associated plates shall not be used as supports. Outlet boxes shall be rigidly supported from structural members.

A. Exact location of floor boxes shall be verified and approved by the Owner prior to concrete pour.

D. Provide proper supports as required by NEC for boxes mounted on conduit stub-ups.

E. Back-to-back and Thru-wall boxes will not be accepted.

END OF SECTION 26 27 26

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SECTION 26 28 13 - FUSES

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. Cartridge fuses rated 600 V ac and less for use in the following:

    a. Control circuits.
    b. Motor-control centers.
    c. Panelboards.
    d. Switchboards.
    e. Enclosed controllers.
    f. Enclosed switches.

2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit Coordination charts and tables and related data.
5. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures, Section 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
4. Coordination charts and tables and related data.

1.5 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than [100 deg F (38 deg C)] apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type T: 250-V, zero- to 1200-A rating, 200 kAIC time delay.

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. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Finish: Gray, baked enamel.
2. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
3. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

1. r fuse covers with open fuse indication.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Construction Manager.

3.3 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

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SECTION 26 28 16 - SAFETY SWITCHES

PART 1 - GENERAL

1.1 SCOPE:

A. This section deals with safety switches for branch circuits and general use.

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES:

A. Switches shall be quick-make, quick-break, NEMA heavy duty type HD sized as shown on drawings and as specified, fused or non-fused as shown or as required to maintain NEMA and UL listing of equipment served. Switch blades shall be fully visible in the off position. Switches shall not utilize circuit breaker components or butt type blow-off contacts.

B. Lugs shall be mechanical for copper conductors and sized for conductors as shown.

C. Safety switches shall be of the same manufacturer as all other distribution equipment

D. Switches shall be by Square D or ITE Siemens or Eaton to match the switchboard and panelboard manufacturer.

PART 3 - EXECUTION:

2.2 SAFETY SWITCHES:

A. Safety switches shall be installed as shown on the plans and in accordance with NEC. Locate for proper clearance and access.

B. Disconnect switches for motors shall be rated in horsepower and shall be sized for motor served.

C. Disconnect switches for non-motor loads shall be sized in accordance with equipment full load current. Safety switches shall be installed in NEMA 1 enclosures except where installed in locations subject to moisture or within kitchens and/or installed outdoors in which case safety switches shall have a NEMA 4X stainless steel enclosure and except where other types of enclosures are shown or indicated on the drawings.

D. Adequate support shall be provided for mounting safety switches. Switches shall not be mounted directly to the equipment they serve. Switches shall be located so that the equipment served may be removed without dismantling the branch circuit.

E. Mount safety switches 60" AFF to top of enclosure U.O.N.

F. Provide Class R type fuses and rejection clips and auxiliary contacts for all safety switches for elevator equipment.

END OF SECTION 26 28 16

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SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 ALTERNATE (Not applicable)

1.2 RELATED DOCUMENTS

A. General: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work specified of this section. . **The generator set and all ancillary components, controls, annunciation and functions shall be provided and meet all requirements as set forth by NFPA 110, NFPA 99 and all Agency for Health Care Requirements (AHCA) as a Level 1, Type 10, Class 72 generation system as defined by NFPA 110 and NFPA 99.** There will be One (1) Natural Gas-Powered Generator Set rated 750 kW, 120/208vac, 3 phase, 4 wire, 60 Hz @ 1800 RPM and One (1) Deisel Powered Generator Set rated 250 kW, 120/208vac, 3 phase, 4 wire, 60 Hz @ 1800 RPM**.** Equipment manufactured by Caterpillar and Kohler is considered acceptable for bidding this project**.**

1.3 DESCRIPTION

A. General: This section describes materials, installation and testing of an engine generator set with integral main circuit breakers; state approved and registered fuel tank and auxiliary support system, to be used for emergency and standby power in the event of a utility power failure.

1.4 SUBMITTALS

A. Shop Drawings: Submit shop drawings in accordance with applicable sections of this specification.

B. Submission: Show applicable ratings, sizes, materials, manufacturers and part numbers, and overall dimensions and weights, for the following equipment:

1. Itemized bill of material
2. Manufacturer and model of engine
3. Manufacturer and model of generator
4. Control panel
5. Battery charger
6. Batteries and rack
7. Electric governor
8. Base mount double containment fuel tank, accessories and piping.
9. Exhaust silencer
10. Integral main line circuit breakers
11. Base and isolators
12. Annunciator panels

13. Voltage regulator

14. Jacket water heaters

15. Fuel, lube oil and intake air filters

16. System schematic diagram showing wiring interconnections with sizes and quantities.

17. Modification fact sheet giving fuel, coolant, lubricating oil, and exhaust and ventilation requirements.

18. Torsional vibration analysis for engine and generator.

19. Factory test report.

20. A start-up inspection report signed by the engine manufacturer's authorized field service representative.

21. Provide an information copy of the standard engine inspection and maintenance service contract. The contract shall be for the complete system including all auxiliary support systems.

22. Emissions

23. Remote Weatherproof Shunt Trip Operators

24. The name and location of parts and service facility which shall service equipment.

25. Parts and service as required in this section for engine and generator. Submit preventive maintenance program.

26. Manufacturer's Warranty

27. Bore, stroke, piston, speed and number of cylinders.

28. Engine displacement.

29. Temperature rise by resistance of both rotor and stator, maximum KVA and KW rating, generator efficiency, type of excitation, generator regulator and regular accessories.

30. Submit current cost of oil sampling.

31. Shop drawings on exhaust muffler and exhaust piping showing all parts, dimensions, and required mounting accessories.

31. Dimensions, installation, and connection requirements for generator units.

33. CFM requirements for each generator.

34. Manufacturer's recommended hours of operation between overhauls.

35. Submit generator thermal damage curve, generator current decrement curve and overcurrent protective device curve on full size 11" x 17" log-log paper. Time in

seconds on Y axis and current on X axis.

36. Submit load stepping program for generator start sequence.

37. Provide a vertical up-blast discharge hood on the radiator end of the enclosure.

38. Provide wired and connected Battery Heaters

39. Provide pre-wired and connected enclosure heaters

40. Provide weatherproof emergency battery lighting and WP gfci duplex receptacle within the enclosure and on the exterior of the enclosure as required by AHCA.

41. Provide unit with remote start capabilities at the remote annunciator

42. Provide unit with WP emergency off switch at the exterior enclosure of the unit.

43. Provide integral generator W.P. galvanized stairs and railing system.

44. Provide lightning protection air terminals as required per AHCA

45. Provide integral 250kw diesel generator fuel tank and 750kw natural gas generation with gas connections to a constant fuel source.

1.5 MANUFACTURER'S SERVICES

A. Manufacturer's Services: Provide authorized equipment manufacturer's services at the jobsite. Install equipment, check the modifications, supervise start-up, and supervise testing and adjustment of the equipment. Provide three man-days to instruct the Owner's personnel in the operation and maintenance manuals prior to this instruction.

1.6 WARRANTY

A. Warranty: Equipment furnished under this section shall be guaranteed against defective parts or workmanship for a period of 5 years comprehensively from date of field testing and acceptance by the Owner, whichever comes last.

1.7 GENERAL PROVISIONS

A. Intent: It is the intent of these specifications to secure, for the purchaser, a diesel engine driven generator set of the latest commercial type and design as specified herein. All material and equipment shall be new and undamaged.

B. Service: It is essential that the engine-generator supplier maintain a local parts and 168 hour/week service facility located within a 60-mile radius of jobsite. In addition, and in order not to penalize the Owner for unnecessary or prolonged periods of time for service or repairs to the emergency system, the generator set supplier must have no less than 60 percent of all engine replacement parts in his stock within the State at all times. Certified proof of this requirement shall be available from the dealer, and a personal inspection of the dealer's facilities shall be made by the consulting engineer or his appointed representative to substantiate claims made by the generator set supplier. The supplier shall provide test supervision necessary for final acceptance and testing. The generator set supplier shall provide all equipment including base mount fuel tank and fuel piping. All power feeders and service entrance conductors and conduit shall be provided and completely installed by the Contractor. All generator control alarm and interlock wiring including conduit shall be completely provided by the Contractor. The Contractor shall be responsible for the generator set supplier and related requirements.

PART 2 - MATERIALS

2.1 MANUFACTURERS

A. Manufacturer: The generator, and major items of auxiliary equipment, shall be manufactured in the U.S. by manufacturers currently engaged in the production of such equipment.

B. Location and Parts: An authorized distributor maintaining a parts depot and 168 hour/week service facility shall be located within a 60-mile radius of the jobsite.

C. Qualifications: The engine-generator manufacturer shall be an authorized full-service distributor. Dealers are not acceptable.

D. Manufacturers: Accepted Manufacturers shall be Caterpillar, Kohler.

E. General: The units shall be manufactured in the U.S.A. and shall be the product of a firm regularly engaged in the manufacture of engine sets and shall meet the requirements of these specifications. It must be a standard model in regular production at the manufacturer's place of business. Engine, generator and control panels shall be serviced by the same supplier so that there shall be one source and one responsibility.

2.2 RATING

A. General: The rating of the **natural gas standby engine-generator** shall be as listed below and based on operation when equipped with all operating accessories, including air cleaners, fans, lubricating oil pumps, fuel injection pump, and jacket water pump. The specified standby KW shall be rated for continuous electrical service during interruption of the normal utility source. The engine generator shall have the following ratings:

1. Standby KW: 750
2. Engine Speed: 1800 RPM
3. Voltage: 120/208 volts, 3 phase, 4 wire
4. Frequency: 60 hertz
5. Power Factor: .8
6. Altitude: 30 feet above sea level.
7. Engine Room Temperature: 120 degrees F. maximum, 40 degrees F. minimum.

B. General: The rating of the **diesel standby engine-generator** shall be as listed below and based on operation when equipped with all operating accessories, including air cleaners, fans, lubricating oil pumps, fuel injection pump, and jacket water pump. The specified standby KW shall be rated for continuous electrical service during interruption of the normal utility source. The engine generator shall have the following ratings:

1. Standby KW: 250
2. Engine Speed: 1800 RPM
3. Voltage: 120/208 volts, 3 phase, 4 wire
4. Frequency: 60 hertz
5. Power Factor: .8
6. Altitude: 30 feet above sea level.
7. Engine Room Temperature: 120 degrees F. maximum, 40 degrees F. minimum.

2.3 ENGINE

A. General: Provide an engine with the following features.

1. Full compression ignition diesel

2. Four-stroke cycle

3. Water cooled

4. Replaceable cylinder liners

5. Replaceable valve seat inserts

6. Capable of the rated output when operating on a commercially available No. 2 diesel oil (ASTM D 396).

7. Capable of extended no load operation without loss of lubricating oil.

B. Accessories: Provide the engine with the following accessories:

1. Fuel, lube oil, and intake air filters

2. Intake air silencer, high frequency type

3. Lube oil cooler

4. Flexible fuel lines

5. Gear-driven water pump

6. Coolant and oil drain valves

7. Fuel priming pump

8. Fuel cooler for return fuel installed on radiator or as required

9. Crankcase fumes disposal system

10. Engine control wiring - multi-strand plastic insulated cable enclosed in nylon flexible slotted conduit terminated in bulkhead fittings.

2.4 SET PERFORMANCE

A. Regulation of generator output voltage from no load to full load shall not exceed ± .25 percent of rated voltage.

B. Regulation of generator output frequency under steady state conditions shall not exceed ±0.5 percent of rated frequency.

C. Upon a one step application of 100 percent of rated KW, voltage drop shall not exceed 20 percent of rated voltage for no more than 1 second.

D. Under any 3 phase, line to line, or line to neutral short circuit condition, set shall produce 250 to 500 percent of rated current and 90 to 100 percent of rated voltage for at least 10 seconds allowing sufficient time for the downstream breaker to clear a fault condition.

E. Harmonic distortion of output wave form under full load conditions shall not exceed 5 percent.

F. Document all tests and make them available.

G. The generator set shall be equipped with time delay relays and required wiring as required to load step the connection of various loads onto the generator to maximize the starting capacity of the unit. Load stepping shall include up to (6) different load profile connections.

2.5 STARTING

A. Starting Motor: A DC electric starting system with positive engagement drive shall be provided. The motor voltage shall be as recommended by the engine manufacturer.

B. Automatic Control: Fully automatic generator set start stop controls in the generator switchboard shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, overcrank, and two auxiliary contacts for activating accessory items. Controls shall include a 30 second single cranking cycle limit with lockout.

C. Batteries: A lead acid storage battery to be used in conjunction with the electric starting system and generator control switchgear shall be provided for each engine. The batteries shall have sufficient capacity to provide for one minute total cranking time without recharging and shall be 12 hour rated. The battery shall be rated by the battery manufacturer in accordance with requirements set forth by the engine manufacturer. Provide a battery rack with bottom insert to insulate the batteries and prevent corrosion and necessary cables, clamps and replaceable connectors. Batteries shall be mounted in the building where shown and required. Wiring shall be sized as required by manufacturer for distance involved.

D. Battery Charger: Current limiting battery charger shall be provided to automatically recharge batteries. Charger shall float at 1.4 volts per cell and equalize at 1.6 volts per cell. It shall include overload protection silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. AC input voltage shall be 120 volts, single phase. Amperage output shall be no less than 10 amperes and size based on load of gear and recharge of battery in 24 hours. Charger shall be Lamarche model A46, Generac or equal. Charger shall have auxiliary contacts to close on low voltage and N.O. AC input for connection to respective generator control cubicle in generator switchboard. Charger shall be capable of fully charging batteries during running conditions and shall be coordinated with generator provided.

E. Provide blanket type battery heaters rated for 120-volt operation, with wattage ratings as recommended by the set manufacturer. Provide heaters with automatic controls to maintain battery electrolyte temperature at not less than 50 or more than 90 degrees F and to de-energize heaters when engine is running.

2.6 GOVERNING SYSTEM

A. Governing system shall be as follows;

1. Provide a Woodward 2301, Barber Coleman or equal, electronic adjustable isochronous governor with electronic speed sensing.

2. Governor shall provide adjustable speed setting from 58 to 62 hertz and maintain the frequency within plus or minus 0.25 percent from no load to full load. Upon load change of not more than 25 percent of rated load, the governor shall re-establish stable operation in not less than one and one-half seconds. Stable operation is defined as operation at a frequency within plus or minus 0.25 percent of rated frequency.

3. The maximum change of frequency during the one and one-half second load change surging period shall not exceed 0.5 Hz.

4. After any sudden load change of not more than 25 percent of rated load, the governor

shall reestablish stable operating conditions in not less than 1-1/2 seconds. Stable operation is defined as operated at a frequency that is constant within plus or minus 0.25 percent of rated frequency.

5. The maximum change of frequency during the one-half second surging period shall not exceed 0.5 Hz.

6. Governor module shall be mounted inside generator control panel.

7. The engine shall be equipped with a compatible actuator and the necessary magnetic pick-up to drive the governor.

8. All connections between the engine governor, engine and switchgear auxiliary switching points shall be made with shielded cable.

9. Governor cable shall not be run in the same conduit with AC control of primary voltages.

B. Cylinder Liners, Pistons, and Valves: Cylinder liners, pistons, and valves shall be as follows:

1. The engine shall be provided with removable wet-type cylinder liners of close-grained alloy iron, heat treated for proper hardness to obtain maximum life.

2. Pistons shall be aluminum alloy with cast iron top ring banks and chrome-faced rings.

3. Valve train shall employ replaceable valve seat inserts; alloy steel valves and cast iron guides.

C. Lubrication: Lubrication shall be as follows:

1. A gear-type lubricating oil pump shall supply oil under pressure to main bearings, crank pin bearings, pistons, timing gears, camshaft bearings and valve rocker mechanism.

2. Pistons shall be spray cooled.

3. Effective full flow lubricating oil filters shall be provided and so located that lubricating oil is continuously filtered except during periods when oil is bypassed to protect vital parts such as when filters are clogged.

4. Replacement resin impregnated cellulose type filter elements shall be accessible and easily removable. Filter system shall be equipped with a spring-loaded bypass valve as an insurance against stoppage of lubricating oil circulation in event the filters become clogged.

5. A suitable water-cooled, engine-mounted lubricating oil cooler shall be provided. The diesel oil sump drain shall be brought to the outside of the set for ease of changing oil.

D. Air Cleaners: One or more engine-mounted dry type air cleaners of sufficient capacity to protect working parts of the engine from dust and grit shall be provided.

E. Fuel System: Fuel system shall be as follows:

1. Injection pumps and injection valves shall not require adjustment in service. The engine shall have an individual mechanical injection valve for each cylinder, any one of which may be removed and replaced from parts stock.

2. Fuel injection pump shall be positive action, constant-stroke pumps, actuated by a cam driven by gears from the engine crankshaft. Fuel lines between injection pump and valves shall be heavy seamless tubing, and, to eliminate irregularity of fuel injections, shall be of the same length for all cylinders.

3. Fuel system shall be equipped with replaceable fuel filter elements which may be easily removed without breaking any fuel line connections or disturbing the fuel pumps or any other part of the engine. Fuel filter shall include fuel pressure gauge, bypass valve (normally closed), manual shutoff valve.

4. All fuel filters shall be conveniently located in one accessible housing, ahead of injection pump so that fuel shall have been thoroughly filtered before it reaches the pump. No screens or filters requiring cleaning or replacement shall be used in injection pump or injection valve assemblies.

5. Engine shall be equipped with a built-in gear-type engine-driven fuel transfer pump, capable of lifting fuel against a head of 3 feet, for supplying fuel through the filters to the injection pump at constant pressure.

6. Provide a water separator on the engine just ahead of the fuel filters constructed of heat-resistant glass, with aluminum-perforated baffle for viewing amount of water contained.

7. Provide pre-engineered, skid mounted base mount double containment diesel fuel tank with rupture alarms. Provide on-site fuel load for 72 hours of run time at full load. Tank must be constructed in accordance NFPA 30, FDEP, UL-142 and UL-80. Tank shall have a high-level alarm, low level alarm and high-level automatic shutoff and shall be capable of sending all AHCA required on and off-site electronic alarms.

F. Jacket Water Heater: Jacket water heater shall be as follows;

1. Provide a unit-mounted thermal circulation-type water heater incorporating a self-contained thermostatic switch, controlled by the exit coolant temperature from the heater to maintain engine jacket coolant to 90-degree F.

2. The heater shall be single phase, 60 Hz, 120 volts. Heater shall be Chromalox, or Kim-Hotstart.

3. Provide hand valves in the heater hoses to facilitate changing heating elements without draining the entire cooling system.

G. Engine Instrument Panel and Safety Switches per AHCA .

1. Engine Instrument Panel: Provide an engine-mounted instrument panel with gauges for items in the following table.

2. Safety Switches: Provide devices for indication and control of the items in the following table requiring pre-alarm and shutdown: Note: This is a partial list and the requirements as set forth in NFPA 99 is required to be met.

Indicator Function (at Battery Voltage)	CV	S	RA
(a) Overcrank	X	X	X
(b) Low Water Temp. <70° F (21° C)	X		X
(c) High Engine Temp Prealarm	X		X
(d) High Engine Temperature	X	X	X
(e) Low Lube Oil Pressure Prealarm	X		X

(f) Low Lube Oil Pressure	X	X	X
(g) Overspeed	X	X	X
(h) Low Fuel Tank (@ 12 hrs. fuel remaining)	X		X
(i) EPS Supplying Load	X		X
(j) Control or Test Switch Not in Auto. Position	X		X
(k) Battery Charger Malfunctioning	X		X
(l) Low Voltage in Battery	X		
(m) Lamp Test	X		
(n) Contacts for Local & Remote Com. Alarm	X		X*
(o) Audible Alarm Silencing Switch			X
(p) Low Starting Air Pressure	X		
(q) Low Starting Hydraulic Pressure	X		
(r) Air Shutdown Damper when used	X	X	X
(s) Remote Emergency Stop Weatherproof		X	

KEY:
CV Control panel-mtd. visual indication
RA Remote Audible
S Shutdown of EPS
X Required
* Remote common for l, m, p, q, & s

H. Exhaust System: The exhaust system shall be as follows:

1. Exhaust system shall consist of a critical silencer, Maxim M51, Donaldson TCU Series or equal, offset flexible exhaust fitting. Offset exhaust piping (where required), insulation, and offset mounting hardware are custom fabricated and installed by the contractor. Install muffler and exhaust piping as required per manufacturer for indoor applications. Pipe size to be coordinated to allow for any backpressure issues.

2. Provide a critical type silencer constructed of milled steel. Silencer shall reduce noise to 75 dba at 25 feet. Provide offset brackets, companion flanges, gaskets, and fasteners.

3. Provide Type 316 stainless steel bellows-type offset flexible exhaust fitting no more than 18 inches long.

4. Provide horizontal discharge tailpipe and wall thimble. Undercut at 45 degrees and cover with 80 percent expanded galvanized metal bird screen by installing contractor.

5. Provide insulated exhaust system consisting of adapters, elbows, lined bellows, piping, supports, drain tees, and support assemblies.

6. Pitch horizontal runs of exhaust pipe away from the engine. Provide condensate traps with petcocks or valves at low spots in the exhaust system.

7. Inlet and outlet size shall be as required by engine manufacturer.

8. Inlet and outlet size shall be as required by engine manufacturer.

9. Provide rain cap and bird screen on end of tailpipe.

2.7 EXHAUST EMISSIONS

A. General: To maintain environmental quality, the engine shall be EPA Certified according to the Unites States Environmental Protection Agency or have suitable emission control. Equipment to

ensure that gaseous exhaust emissions do not exceed Federal regulations.

Verification of the ability to meet emission specifications shall be available from the engine manufacturer.

2.8 GENERATOR

A. General: Provide the following:

1 The random wound generator shall be a 3 phase, 60 Hz, 277/480 volt, insulated, single-bearing, drip-proof, rotating field, synchronous type, with 3 phase brushless PMG exciter.

2 Provide Class H insulation limited to 125 degrees C rise.

3 Provide 100 percent epoxy varnish impregnation and a coat of epoxy asphalt insulating material to increase resistance to abrasive dust or sand, high humidity, and light acidic, oil, or salt-laden atmospheres, as well as prevent fungus growth.

B. SCR Equipment: Generator shall be designed for operation of SCR type equipment.

C. Wave Form: The wave form deviation factor of the line-to-line voltage at no load and balanced rated load at 0.8 power factor not to exceed 4 percent. The rms of all harmonics shall be less than 2 percent and that of any one harmonic less than 1 percent at full rated load. TIF shall be under 50.

D. Transient Dip: The transient dip shall not be greater than 20 percent of rated voltage when full load at rated power factor within 5 cycles is applied to the generator.

E. Voltage Regulator: Provide a static type voltage regulator to maintain a constant and stable generator output voltage within plus or minus 0.5 percent of nominal for all steady-state loads from no load to full load with isochronous speed control and plus or minus 2 percent speed droop operation. A 5 percent variation in frequency and the effects of field heating will not affect the unit's regulation. Provide stability and voltage range adjustments.

F. Fault Current: Provide permanent magnet generator boost to provide a minimum of 300 percent of fault current for 10 seconds.

2.9 STRUCTURAL STEEL BASE

A. Base: Isolate the structural steel base from the engine with isolators with neoprene-jacketed pre-compressed molded fiberglass noise isolation pads, steel load plate, built-in leveling bolt, welded steel or cast housing, and high deflection steel springs.

B. Isolators: Isolators shall be Peabody Noise Control, Inc.; Kinetics brand, Type SM; Norfund or Dynamics Corporation or equal.

2.10 COOLING SYSTEM - ENGINE MOUNTED RADIATOR

A. Radiator: Provide an engine-mounted radiator with blower-type fan sized to maintain rated full load continuously at the specified maximum ambient temperature of 50C.

B. Coolant Switch: Equip the radiator with a 1-inch-wide duct adapter flange and low coolant level switch with 1 N.O. and 1 N.C. contact.

C. Airflow: Airflow restriction from the radiator shall not exceed 0.50-inch water.

D. Fluid: Fill the engine cooling system with a solution of 30 percent by volume ethylene glycol with rust inhibitor.

2.11 GENERATOR CONTROL PANEL

A. General: Provide a NEMA 1, vibration isolated, dead front, 12-gauge steel control panel with lockable hinged cover. Mount and wire the control panel to the engine-generator set. The panel shall include the following equipment:

1 Voltmeter, 1 percent accuracy with 3 phase fuse protection digital type to read true rms.

2 Ammeter, 1 percent accuracy, digital type to read true rms.

3 One ammeter and one voltmeter phase selector switch.

4 Frequency meter, 1 percent digital type.

5 Running time meter.

6 Instrument transformers: Automatic starting controls, cycle crank.

7 Voltage level adjustment rheostat, minus 25 to plus 10 percent.

8 Dry contacts for remote alarms wired to terminal strips.

a. Fault indicator lights with press to test feature for low oil pressure, high coolant temperature, low coolant level, overspeed, and overcrank.

9 Visual alarm indicators for impending shutdown from oil pressure and high coolant temperature.

10 Visual alarm indicators for low fuel level and low coolant temperature.

11 Three-position function switch marked "manual", "off/reset", and "auto".

12 Emergency engine stop pushbutton.

13 Panel illumination lights and switch.

B. Components: Pilot lights and pushbuttons shall be standard duty type.

C. Devices: Provide relays and timing devices with clear polycarbonate dust covers. Devices shall be plug-in type with holddown spring retainers. Output contacts shall be rated 10 amperes at 24-volt dc.

D. Controls: Provide engraved or etched nameplates to show position of switches and function of pilot lights, pushbuttons, and meters.

E. Provide fully automatic set start-stop controls in the generator panel. Controls shall operate as follows;

1 With switch in automatic position closure of a set of external contacts or switch in manual position, the engine shall automatically crank.

2 An adjustable cranking limiter shall allow from 2 to 5 cycles of 30 seconds continuous cra

nking.

a. If the engine fails to start, starting circuit shall be locked out and the overcrank light illuminated.

3 The engine will shut down when operating in the automatic mode and the remote engine run contact open.

4 Initiation of any safety shutdown shall immediately stop the engine and light the appropriate light.

5 Upon correction of the fault, the shutoff system shall be made operable by moving the function switch to off/reset and then back to the "auto" position.

F. Main Line Circuit Breaker: Provide internal main line circuit breakers as follows;

1 Provide integral 100% rated 3-pole 600-volt weatherproof rated main line solid state circuit breakers sized per Drawings. Solid state circuit breakers shall have adjustable settings for long-time, short-time instantaneous, long-time delay and heat-time delay.

2 Install on the generator in an enclosure to function as a load circuit interrupting and protection device.

3 Circuit breakers shall be trip free of the handle.

4 The handle position, or a luminescent flag, shall indicate "off", "on", or "tripped" breaker positions.

5 The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short-circuit protection. Breaker shall also include an integral 24-volt D.C. shunt trip for remote trip.

6 Insulated neutral terminals and a ground terminal shall be provided and marked.

7 Circuit breakers shall meet standards established by UL, NEMA, and NEC.

8 Do not use generator exciter field circuit breakers.

9 Manufacturer: Eaton, Square D, Siemens.

PART 3 - EXECUTION - EMERGENCY GENERATOR - MISCELLANEOUS REQUIREMENTS

3.1 GENERAL

A. Miscellaneous Requirements: Provide the following:

1. Equipment nameplate.
2. Operating manual (5 copies).
3. Parts list (5 copies).
4. Special tools (as required).
5. Lubricants (6 months supply).
6. As-built shop drawings (5 sets).
7. Services of a Manufacturer's Representative, minimum five (5) days.
8. Start sequence staging Program.

3.2 PREVENTIVE MAINTENANCE PROGRAM REQUIREMENT

A. General: The manufacturer of the Power Generation System equipment shall develop a computerized preventative maintenance program. Specific recommendations for actual equipment application shall be made for a computerized program based on operating hours and/or elapsed time. The preventative maintenance recommendations shall be submitted with the shop drawings.

3.3 SYSTEM SERVICE CONTRACT

A. General: The supplier of the power system must provide a copy of and make available to the Owner his standard service contract which, at the Owner's option, may be accepted or refused. This contract shall accompany any documents, drawings, catalog cuts, specification sheet, wiring or outline drawings, etc. submitted for acceptance to the designing engineer.

3.4 REMOTE ALARM ANNUNCIATION

A. General: All necessary and AHCA required relays and wiring shall be provided by the generator system supplier for remote annunciation for the generator per NFPA 110 and NFPA 99 including the remote annunciator shall have the following individual audible and visual signals. All visual signals shall have a push to test lamp pushbutton and the unit shall be equipped with a remote start :

1. Normal power on/off.
2 Generator running.
3. Pre-alarm trouble on generator.
4 Generator trouble shutdown.
5. Emergency system power on/off
6. Diesel tank low level.
7. Diesel tank rupture.
8. Battery charger malfunction
9. Low oil pressure
10. Low water temperature
11. Excessive water pressure
12. Low Fuel level- when the main fuel tank contains less than a 4-hour operation.
13. Overcrank (failed to start)
14. Overspeed

15. Provide all hardwired communication cables in conduit for remote annunciator operation.
16. Device shall be provided with a storage battery back-up and shall be battery powered.
17. Remote start , stop and remote transfer.

3.5 FUEL (BY CONTRACTOR)

A. General: Fill the tank with No. 2 fuel oil meeting ASTM D 396. After field testing is complete, refill the tank.

B. SUB-BASE FUEL TANK: Comply with NFPA 30

1. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following: 1. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of tank. a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of tank leak.

2. Tank Capacity: As recommended by engine manufacturer for an uninterrupted period of 72 hours operation at 100 percent of rated power output of engine-generator system without being refilled.
3. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
4. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.
5. High-Level Alarm Sensor: Liquid-level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.
6. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.
7. Tank level indicator.
8. Vandal-resistant fill cap.
9. Tank shall be double wall with leak detection.
10. Containment Provisions: Comply with requirements of authorities having jurisdiction.
11. Perform Breach Integrity testing on site prior to filling with fuel (FDEP, NFPA-30)
12. Provide all required documentation and carry out inspections in order to license the fuel tank per the requirements of the State of Florida.

3.6 WEATHERPROOF ENCLOSURE:

A. Description:

1. Vandal-resistant, sound-attenuated, weatherproof aluminum housing with 0.125-inch-(3-mm-) thick walls; wind resistant. Multiple panels to be lockable and provide adequate access to components requiring maintenance, minimum two doors per side. Access to controller and main line circuit breaker in accordance with NFPA 70. Panels to be removable by one person without tools. Instruments and controls to be mounted within enclosure.

B. Source Limitations: Obtain enclosure from engine-driven generator manufacturer.

C. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 186 MPH

D. Hurricane-Rated Aluminum Sound Enclosure:

1. Constructed in accordance with the Florida Building Code.

2. Enclosures are tested and certified in accordance with the following standards:

a. Large Missile Impact Level E (FBC TAS 201-94).

b. Uniform Static Air Pressure (FBC TAS 202-94).

c. Cyclic Wind Pressure Loading (FBC TAS 203-94).

d. Ultimate Design Pressure - Wall Panels ± 65PSF.

e. Ultimate Design Pressure - Roof Panels ± 100PSF.

3. Enclosures must be tested and certified by a certified third party

E. Access doors and panels rubber sealed to prevent water intrusion and minimize noise.

F. Hinged Doors: Lockable; keyed alike with recessed locks.

G. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination operating limits required by engine generator components.

H. Insulation Flammability Classification: UL 94 HF1.

I. Muffler Location: Complete exhaust system located within enclosure.

J. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits.

1. Inlet Plenum: Vertically louvered and acoustic-lined plenum, constructed from a minimum of 0.125-inch- (3-mm-) thick formed heavy-duty aluminum panels.

2. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers limiting entry of rain and snow.

3. Outlet Plenum: Acoustic-lined plenum, constructed from a minimum of 0.125-inch- (3-mm-) thick formed heavy-duty aluminum panels with 90-degree angle to discharge air up.

3.7 STARTUP

A. Initial: On completion of the installation, the initial startup shall be performed by a factory-trained service representative of the engine supplier, who shall thoroughly inspect, operate, test and adjust the equipment.

B. Provisions: The inspection shall include the soundness of all parts, completeness of all details, proper operation of all components with special emphasis on safety devices, correctness of settings, proper alignments, and correct phase rotation to match other sources.

C. Tests: Field tests shall include the following:

1. Simulate power failure by tripping the main breaker and demonstrate complete manual and automatic start, load, unload, and stop sequence of the engine-generator.

2. Conduct a two-hour run with generator operating, utilizing maximum available load. If available load is less than 100% of the generator's rating, then furnish and add loads to obtain 100% generator loading.

3. Conduct a block loading test in accordance with NFPA-110.

4. Conduct a load start up test demonstrating the load staging program as stated.

5. Conduct all generator acceptance testing requirements of NFPA 110 Rule 7.13.4.1.3.

END OF SECTION 26 32 13

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SECTION 26 36 00 - AUTOMATIC TRANSFER SWITCH

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. General: Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION

A. General: Provide automatic transfer switches of the size, quantity, number of poles, amperage, voltage and withstand ratings as shown on the contract drawings and as specified herein.
The Automatic Transfer switches shall meet all requirements as set forth by NFPA 99, NFPA 110 and Agency for Health care requirements (AHCA)

B. Description: Using a NEMA 1 indoor enclosures, the switches shall automatically transfer the load to the generator during normal power outages. The switches shall be fully rated, electrically operated, mechanically held unit with both electrical and mechanical interlocks to prevent simultaneous energizing of both sides. Switch shall be a 600-volt class.

1.3 QUALITY ASSURANCE

A. Manufacturer Requirements: Firms regularly engaged in manufacture of automatic transfer switches, of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Manufacturers: Subject to compliance with the requirements of this specification, provide an automatic transfer switch manufactured by the following:

1. Cummins
2. Generac
3. ASCO
4. Kohler Company
5. Russ Electric.
6. Caterpillar.

C. Standards: Comply With The Following Standards:

1. UL-1008

   a. As a precondition for acceptance, transfer switch, complete with timers, relays and accessories shall be listed by Underwriters Laboratories, Inc. in their Electrical Construction Materials Catalog, and accepted for use on emergency systems as defined in NFPA 110 and NFPA 99.

   b. When conducting temperature rise tests to Paragraph 99 of UL-1008 the manufacturer shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.

   c. Produce UL 1008 closing and withstand ratings for 3 cycles at 208v volts. certified test reports from an independent testing laboratory to verify the identical samples have been subject to three phase short circuit current at voltage indicated on drawings, for a minimum of 3 cycles duration, without contact damage or contact welding and without the use of current limiting fuse protection.

1.4 SUBMITTALS

A. Shop Drawings: Provide all equipment cabinet dimensions and wiring diagrams.

B. Product Data: Provide all applicable options, accessories, and interrupting or withstanding current ratings. Provide all electrical characteristics and data to show compliance with these specifications.

C. Testing: Provide test results from UL 1008 as listed above.

1.5 PRODUCT HANDLING

A. Equipment Storage: The Contractor shall store items provided under this specifications until time of installation. Such storage shall meet the requirements of the system supplier and be accepted by the Engineer. The stored equipment shall not be delivered to the site until it is to be installed.

B. Protection: Use all means necessary to protect the materials of this section before, during and after installation and to protect the installed work and materials from the activities of all other trades.

C. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Engineer and at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Type: Provide 3-pole, 4-wire, 42KAIC rated, Solid Neutral 3-phase 120/208volt rated, open transition with in-phase monitor automatic transfer switch sized as shown on plans, with full load current and voltage rating as shown, 60 Hz normal and emergency. Provide service entrance rated automatic transfer switches with integral Main circuit breaker complete with LSIG as indicated on the drawings.

B. Load Types: The transfer switch shall be capable of switching all classes of load and shall be rated for continuous duty when installed in an enclosure that is constructed in accordance with Underwriters Laboratories, Inc., Standard UL-1008.

C. Accessories: All relays, timers, control wiring and accessories to be front accessible.

D. Withstand rating shall be 200,000 amps rated with current limiting fuses.

E. Provide Nema 3r Manual transfer switch (MTS) as indicated on the drawings.

2.2 COMPONENTS

A. Features: Provide the following transfer switches with the following features:

1. The transfer switch shall be double throw, actuated by a single electrical operator momentarily energized; and mechanically connected to the transfer mechanism by a simple over center type linkage with a total transfer time not to exceed 1/6 of a second.

2. The mechanism shall be a high-speed actuator, capable of transferring successfully in either direction with 75 percent of rated voltage applied to the switch terminals.

3. Circuit breaker switches are not acceptable.

4. Mechanical interlocking of transfer switches to prevent unintended interconnection of the normal and alternate sources of power.

5. A means of safe manual operation of the transfer switch.

B. Main Contacts: The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be fully rated, arc quenching, mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnet, or springs and shall be renewable silver-tungsten alloy protected by arcing contacts, with magnetic blowouts on each pole. Contacts shall be able to withstand high fault current levels without contact damage or separation. Parallel main contacts are not acceptable.

C. Exercise Timer: Include an exerciser with the transfer switches for exercising the generator in loaded or unloaded condition, with a cycle of 1, 7, 14, 28, or 365 days for a period adjustable from a minimum of 20-minute intervals to 10 hours.

D. Engine Start Delay: Time delay to override momentary normal source power outages to delay engine start signal and transfer switch operation. Adjustable 0.5 to 6 seconds, factory set at 3 seconds.

E. Load Test Switch: Load test switch to simulate normal power failure. (Maintained type).

F. Contact Failure indicators: Contact to close on failure of normal source to interface with data acquisition panel. Contact to open on failure of normal source to initiate customer functions.

G. Pilot lights: Green pilot light on the cabinet door to indicate the main switch in normal position. Red pilot light on the cabinet door to indicate the main switch in emergency position. All pilot lights to have push to test function.

H. Auxiliary Contacts: Provide an auxiliary contact closed in normal position. Provide an auxiliary contact closed in emergency position.

I. Additional Contacts: Two sets of relay contacts shall be provided to open and close upon loss of the normal power supply.

J. Provide internal adjustable time delay relays in order to provide application of power for the generator start load stepping program.

K. Provide Time delay relays for transfer to EPS, commencement, retransfer to primary source, time delay bypass if EPS fails, time delay on engine shutdown,

2.3 OPERATION

A. Low Voltage: Provide engine starting contacts in transfer switches to start the generating plant if any ungrounded phase of the normal source drops below 75 percent of rated voltage, after a non-adjustable time delay period of 1 to 6 seconds, to allow for momentary dips.

B. Transfer: The transfer switch shall transfer to emergency as soon as the generator source voltage and frequency have reached 90 percent of rated values.

C. Stabilization; After restoration of normal power on all phases to 90 to 95 percent of rated voltage, adjustable time delay period of 0 to 60 minutes shall delay transfer to normal power until it has had time to stabilize. If the emergency power source shall fail during the time delay period, the time delay shall be by-passed, and the switch shall return immediately to the normal source.

D. Generator No-Load Operation: Whenever the switch has retransferred to normal, the engine-generator shall be allowed to operate at no load for an adjustable period of time (0 to 60 minutes) to allow it to cool before shut-down.

E. Test Switch: The transfer switch shall include a test switch to simulate normal power failure with actual load transfer.

F. Time Delays

1. The control module shall include four-time delays that are fully field-adjustable by keypad or keyboard in increments of 1 second over the entire range.

2. Adjustments and viewing of the time delay values shall be accessible when the enclosure door is closed.

3. Microprocessor controller shall indicate time relay in progress.

4. Required Time Delays

a. Time delay for engine start to delay initiation of transfer for momentary source outages: Range 0-6 seconds. Factory set at 5 seconds.

b. Time delay for transfer to emergency: Range 0-5 minutes. Factory set at 5 seconds.

c. Time delay for transfer back to normal: Range 0-60 minutes. Factory set at 5 seconds.

d. Time delay for engine cool-down: Range 0-60 minutes. Factory set at 5 seconds.

5. Input values outside the allowable parameters shall cause a "range error" message to be displayed.

G. The user shall have the ability to manually program an engine start and run for a period of up to 10 hours in the loaded or unloaded mode of operation. The time delay transfer to emergency and/or normal may be bypassed during the run period. A numeric indication shall be displayed of the run time remaining in hours and minutes. The run period may be stopped at any time with a single keystroke. After the run period has stopped, the engine shall run unloaded for the cool down time.

H. User terminals shall be available to connect a normally closed contact that, when opened, signals the control module to start and transfer load to the engine-generator. Closing these contacts shall initiate a retransfer and engine cool down sequence. The load shall be transferred to an available utility source immediately if the generator source should fail.

I. The following features shall be built into the control module logic. These features shall be enabled at the factory or in the field by installing an insulated program jumper provided by the vendor as standard.

1. Anti-single phasing protection shall detect regenerative voltage as a failed source condition.

2. In-phase monitoring shall continuously monitor the contactor transfer times, source voltage, frequency and phase angle to provide a self-adjusting, zero crossing contactor transfer signal.

3. Manual operation override shall function to bypass any manual switch accessories if the source to which the transfer switch is positioned fails. This program jumper shall be factory installed.

4. All phases of normal and all or single phases of emergency shall be monitored for overvoltage and single phase of normal and emergency for over- and under-frequency. The values shall be programmed with the enclosure door closed.

J. Status Indicators

1. Light-emitting diodes shall indicate the status of the Contractor Position.

2. System Status

a. Transfer Switch Position Sensing Fault

b. Transfer Switch Fail to Transfer
Internal Control Module Fault
Manual Transfer Operation

c. Programming Switch Not In Off

e. The system status messages shall also be shown on the alphanumeric display.

a. Remote control start and stop and status indication

5. Accessory Active

Plant Exerciser
In-Phase Monitor
Load Shed
Area Protection

6. A lamp test push button shall light all light-emitting diodes.

K. The control module shall have a three-position, key-operated, programming control switch. The key shall be removable in any position. The positions shall be:

1. Off--Allows all enabled accessories to be monitored only. Settings cannot be changed while in this position.

2. Local--Allows all enabled accessory settings to be changed by local keypad entry.

3. Remote--Allows all enabled accessories to be altered via the remote communications port.

4. Provide for individual remote control of all start and stop functions of all transfer switches.

L. A momentary-type test switch shall be provided to simulate a normal source failure.

M. The transfer switch shall be able to control up to 10 isolated form C auxiliary contacts for indication of switch position and source availability.

N. The transfer switch shall have load-shed and sequencing capability to allow up to nine selected loads to be disconnected prior to transfer in either direction. It shall be possible to vary the time sequence for reenergizing of the nine loads.

O. A set of gold-flashed contacts rated 10 amps, 28VDC shall be provided for a low-voltage engine start signal when the normal source fails.

PART 3 - EXECUTION

3.1 CONDITIONS

A. Inspection: Prior to performing the work required by this section, carefully inspect the installed materials and equipment of all other trades and verify that the project has progressed to a point where this inspection may properly begin.

B. Verification: Verify that all equipment provided under this section of the specification may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.

C. Discrepancies: If any discrepancies are found, immediately notify the Engineer. Do not proceed with the installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 CONNECTIONS

A. Tightening Connectors: Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A and 486B.

END OF SECTION 26 36 00

SECTION 26 41 13 - LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Description of Systems:

1. A Lightning Protection System shall be placed on the structure by experienced installers in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Underwriters' Laboratories. Intent of the lightning protection systems shall be to protect the new building against damage by lightning. All equipment to that result shall be included whether or not specifically called for herein. Installers shall be LPI (Lightning Protection Institute) certified, master and Journeyman in accordance with LPI Standards or of equal qualifications as approved by the Owner or the Owner’s authorized representative. A U.L. Master Label for the system and a witness of grounding form, similar to that required by LPI (Form 175-A), shall be required.

2. Materials shall comply in weight, size and composition with the requirements of Underwriters' Laboratories and the National Fire Protection Code relating to this type of installation, and shall be U.L. Labeled.

3. Contractor shall be required to pull a permit for their work and provide a complete package of permit, drawings, specifications and details for a complete turnkey system, including but not limited to:

a. Air terminals
b. Bonding plates
c. Conductors
d. Connectors
e. Fasteners
f. Grounding plates
g. Grounding rods
h. Rod clamps
i. Splicers
j. Fittings
k. Test wells.

1.2 SUBMITTALS

A. Shop Drawings and Product Data:

1. Shop Drawings: Shop drawings shall be submitted for approval before any work is started. Drawings shall include full “to scale” layout of cabling and air terminal points, and connections.

2. Product Data: Product Data shall be submitted on all equipment to show compliance with this section of the specifications and shall include manufacturer's written recommendations for installation. Information shall be submitted for approval before any work is started.

PART 2 - PRODUCTS AND INSTALLATION

2.1 AIR TERMINALS

SECTION 26 51 00 - LIGHTING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE:

A. Lighting fixtures shall be furnished and installed as shown on the drawings and as herein specified in attached schedules.

PART 2 - PRODUCTS

2.1 FIXTURES:

A. Lighting fixtures shall be furnished as shown on drawings and as shown within the Lighting Fixture Schedule and as indicated on the Interior design drawings. It shall specifically be the responsibility of the Contractor to verify the exact type ceiling and or recessing depth of all fixtures and to furnish the exact and proper mounting trims and all accessories required of the specified and/or approved fixtures for the ceiling and application that the fixture is to be installed. All Lighting fixtures shall be provided with a UL Listing, joiner plates, escutcheons, UL fixture tenting, recessed fixture IC ratings, mounting brackets, swivel ball aligners, switch pack relays, emergency bypass shunt relays, dimming ballasts, emergency ballasts, end caps, retaining clips, drywall plaster frames, emergency control relays, poles, concrete bases, housings, concrete bases, structural supporting materials and all other accessories required for a complete fixture installation.

2.2 LAMPS:

A. All fixtures shall be equipped with LED type lamps unless otherwise noted. Lamps shall be installed new, immediately prior to final inspection, and shall not be used for construction.

B. Lamps shall be of size and type as shown in schedules or on drawings.

2.3 SCHEDULES:

A. See schedule of lighting fixtures on drawings.

2.4 FIXTURE SCHEDULE NOTES:

A. Fixture catalog number represents basic luminary size, type, quality and configuration. Accessories shall be furnished with each unit as required for a complete finished installation. Basic accessories shall include, but are not limited to, the following:

1. Ball aligners, joining plates, end caps, retaining clips, emergency ballasts etc.
2. Trims for recessed and surface mounted fixtures to concrete pre-stress or hollow core ceilings.
3. Fixture stems and canopies finished to match fixtures color.
4. Special structural mounting brackets, tenons, slip filters, concrete bases, poles, anchor bolts, junction boxes, clips, and stanchions for all exterior lighting fixtures. Provide all weatherproofing and waterproofing for all lighting fixtures and connections to be installed in exterior or damp locations.
5. UL fixture tenting and proper and required recessed fixture IC ratings.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIXTURES:

A. Structural support of all lighting fixtures shall be the responsibility of the Contractor.

B. Lay-in fixtures for grid type ceilings shall be secured to ceiling grid with approved clips and arrangements for additional ceiling support at each fixture. 1' X 4' and 2' X 2' fixtures shall have 2 each independent additional supports, 2' X 4' fixtures shall have 4 independent additional supports attached to building structural components.

C. All electrical connections shall be to junction boxes. Fixtures located in drywall ceilings shall be direct conduit connected. Provide access panels in ceilings as required for junction box access.

D. Provide drywall flange kits or hanger bars for the mounting of all lighting fixtures to be installed in drywall or plaster ceilings. Field coordinate the exact location.

E. Ceiling mounted fixtures shall be supported independently of ceiling or ceiling tiles and shall be connected, from structural members of building. Minimum of two supports for 4'-0" and 8'-0" fixtures.

F. The system grounding conductor shall be secured to each fixture body by means of a bonding screw.

G. All stems for pendant mounted fixtures shall utilize ball aligner assemblies.

H. Provide canopies for all stem and pendant mounted lighting fixtures and ceiling fans in finished spaces. Provide aligner canopies in finished spaces and swivel hanger box covers in unfinished spaces. All stems, aligners and canopies shall be painted to match the lighting fixture and/or ceiling paddle fan and shall be connected to structural components of the building.

I. Provide all necessary galvanized channels, clips, and bridging as required to span purlins, joists, beams, concrete components, floors etc., for proper lighting fixture system support. Secure channel and bridging for stationary and permanent supporting means that integrates with the building structure and common materials.

END OF SECTION 26 51 00

A. Air Terminals shall be solid aluminum; to be coordinated with the building flashing materials; and shall have proper base support for surface on which they are attached, and shall be securely anchored to this surface. Terminals shall project a minimum of 12" above top of object to which attached.

2.2 CONDUCTORS

A. Roof conductors shall consist of aluminum; to be coordinated with the building flashing materials, complying with the weight and construction requirements of the Code, and shall be coursed to interconnect with air terminals, and in general, provide a two-way minimum path to ground. The angle of any turn shall not exceed 90 degrees, and shall provide an approximately horizontal or downward course. Down conductors shall be copper, and shall be installed in concealed PVC conduit and concealed within the structure. Approved bi-metal transitions from aluminum roof conductors to copper down conductors shall be provided where aluminum building flashing is used.

2.3 FASTENERS

A. Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural Contractor so they may be installed during construction of the project.

2.4 GROUND CONNECTIONS

A. Ground connections shall be made in accordance with requirements of all applicable codes. Ground rods shall be placed in a minimum of two (2) feet from building foundations. In addition to the above requirements additional grounds, one down conductor of each two-path system shall be connected to metallic water piping system with approved water pipe type strap connector. All ground rods shall be a minimum of 5/8" X 50'0” long (sectional) copper-weld type.

B. Provide equipment grounding and bonding connections sufficiently tight to assure permanent and effective grounds and bonds.

C. Grounded metal bodies within the bonding distance determined by the bonding distance requirements of NFPA shall be bonded to the system using bonding conductors and fittings in accordance with code requirements.

D. Underground metallic piping entering the building shall be bonded to the nearest down conductor or ground electrode.

E. Bond to metallic water service, underground metallic piping systems and the building electrical grounding electrode system as shown and as required by codes.

F. Bond to metal bodies of conductance on roof with main size conductors as shown and as required by codes. These bonds include, but are not limited to, exhaust fans and stacks, vents, handrails, ladders, conduits, exhaust fans, HVAC / RTU units, antennas, roof mounted lighting standards, etc. or any large metal body subject to direct stroke or which exceeds the height of adjacent air terminals.

G. Bond to metal bodies of inductance located within 6’-0” of main conductor or other bonded object with approved secondary bonding conductor as shown and as required by codes. Such objects include, but are not limited to: flashing, metal coping caps, gravel guards, fascias, roof drains, downspouts, interior ducts, exhaust fans, HVAC units, boxes, conduits, boxes, machinery or piping, etc., or in general, any isolated body at or below the roof subject to inductance and within 6’-0” of the system.

2.5 INSTALLATION

A. Installation shall be made in an inconspicuous manner with conductors coursed to conceal equipment as much as possible. Down conductors shall be concealed within the structure, and shall be run in 1" PVC concealed conduit. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor. System shall also be tied to the main service electrical grounding electrode conductor system.

2.6 EQUIPMENT

A. Equipment shall be as manufactured by Thompson Lightning Protection, Inc. as specified; or approved substitutions as manufactured by: Independent Protection Company, Inc., Heary Bros. Lightning Protection or Harger (premium lines).

2.7 CORROSION PROTECTION

A. Use no combination of materials that may form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture, unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist that would cause deterioration or corrosion of conductors, use conductors with suitable protective coatings.

2.8 FIELD QUALITY CONTROL

A Provide advance notice of at least 24 hours to the Owner’s Authorized Representative before concealing lightning protection system work.

B. Location of all devices and equipment shall be coordinated with all trade contractors and shop drawings prior to submittal of shop drawings.

C. Coordinate installation with other trades to avoid conflicts.

D. During construction, inspection and testing shall be made to assure a low resistance path throughout the system. Upon completion, the air terminals shall be tested for resistance to the grounding electrode system. Any air terminal which has more than 5 ohms resistance to ground shall be connected by additional approved means to reduce the resistance to 5 ohms or less.

E. The Contractor shall be responsible for inspecting and testing the system and shall furnish all materials, instruments and labor requirement to perform same. Owner’s Authorized Representative shall witness the final test.

PART 3 – EXECUTION (Not applicable)

END OF SECTION 26 41 13

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SECTION 27 05 00 - SPECIAL SYSTEMS

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.

B. Division 26, Section 260500 “General Provisions” and Electrical Identification sections apply to work specified in this Section.

C. Division 26, Section 260533 “Raceways” Section applies to work specified in this Section.

D. Division 26, Section 260519, “Conductors”.

E. Division 26, Section 260533, “Outlet Boxes”.

1.2 SUBMITTALS

A. None.

1.3 SUMMARY

A. Extent, location, and details of special systems work are indicated on drawings. All Systems will be installed above accessible ceilings in accessible locations with overhead “D” ring wire management.

B. Applications of special systems specified in this section include the following:

1. Security, nurse call, and CCTV system raceway.
2. Television, telephone and data communication raceways.

C. Pull Wires, raceways and electrical boxes and fittings which are required in connection with communications systems and are not specified in this section are specified in Division 26, General Provisions sections, “Raceways” and “Electrical Boxes and Fittings”.

1.4 QUALITY ASSURANCE

A. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and the NEC as application to installation of these systems.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate with other electrical work including wire/cables, electrical boxes and fittings, and raceway, to properly interface installation of communications systems with other work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. As indicated.

2.2 SECURITY, NURSE CALL AND CCTV SYSTEM RACEWAY

A. Provide a complete security system raceway, including conduit, terminal boxes, outlet boxes, wireways, wall plates, as indicated on drawings.

B. Coordinate the installation of devices and raceways with the Owner's security system installer.

C. Provide a 200-pound test pull wire or cord in each and every empty conduit.

D. Cable, jacks, devices, equipment and punchdown blocks be by Owner.

E. See drawings for additional conduit, enclosure and raceway requirements.

2.3 TELEVISION, TELEPHONE, & DATA RACEWAY

A. Provide a complete data/communication system raceway, including conduit, terminal boxes, outlet boxes, wireways, wall plates, as indicated on drawings.

B. Coordinate the installation of devices and raceways with the Owner's data/communication system installer.

C. Provide a 200-pound test pull wire or cord in each and every empty conduit.

D. Cable, jacks, devices, equipment and punchdown blocks be by Owner.

E. See drawings for additional conduit, enclosure and raceway requirements.

2.4 COORDINATION

A. Coordinate with Owner's Systems Contractors and Installers concerning equipment and instruments to be installed. Provide all boxes and plates necessary to support the installed equipment.

PART 3 - EXECUTION - NOT APPLICABLE

END OF SECTION 27 05 00

SECTION 28 30 00 – DIGITAL, ADDRESSABLE FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and Division 26 Specification Sections, apply to this Section.

B. **Installer shall meet all applicable codes and standards required by FAC Rule 69A-53 including NEC (2011), NFPA 99 (2012), and NFPA 72 (2010).**

1.2 SUMMARY

A. This Section includes automatic voice evacuation Addressable fire alarm systems, including Fire Alarm Control Panel, voice evacuation amplifier and voice tape recording, fireman microphones and connection outlets, remote annunciator, door hold open devices, manual pull stations, heat and smoke detectors, fire alarm speakers, visual signal equipment, controls, fire and smoke damper connections, stair pressurization and smoke evacuation interconnections and controls, hardware and software interconnections for repeater power connections for Fireman communications systems and surge protection devices. Coordinate all wiring and device interfaces with Owner's representative.

B. The Fire Alarm System shall meet the latest adopted edition of all local, State of Florida and all local and City code amendments, NFPA 72, UL 864-9TH Edition all Federal "ADAG" requirements, Florida Administrative Code 61G15-32.006 and in compliance with the latest adopted edition of the Florida Building Code, NFPA 70 (NEC) and NFPA 101 (Life Safety Code), NFPA 99 (Healthcare Code), Americans with Disabilities Act (ADA) ANSI A117.1, FGI Guidelines For the design and construction of patient care facilities, regulations of the Agency for Healthcare Administration (AHCA) 58a-5 and FC – Chapter 400. Obtain and pay for any and all required permits, inspections and certificates of inspections and approval, and the like, and deliver such certificates to the Engineer.

All devices shall be "red" in color with "white" lettering.

1.3 DEFINITIONS

A. Addressable: Combined hardware and software systems associated with the Fire Alarm Control Panel and field devices which will permit identification or control of an individual device (initiating or signal/control circuit).

B. Alarm-Initiating Device: A manual station, smoke detector or heat detector.

C. Alarm Signal: Signifies a state of emergency requiring immediate action. Pertains to signals such as the operation of a manual station and the operation of a sprinkler system flow switch.

D. Style "4" Initiating Circuits: Circuits arranged and electrically supervised so a single break or single ground fault condition will be indicated by a trouble signal at the fire alarm control panel (FACP) and the circuit will continue to be capable of operation for its intended service in the faulted condition no matter where the break or ground fault condition occurs. (2-wire Class B circuit).

E. Style "Y" Indicating Circuit: Circuits electrically supervised such that a single break or a single ground fault condition will be indicated by a trouble signal at the FACP and the circuit will continue to be capable of operation for its intended service in the faulted condition no matter

where the break or ground fault condition occurs. (2-wire Class B).

F. Multiplex System: One using signaling method characterized by the simultaneous or sequential transmission, or both, and the reception of multiple signals in a communication channel, including means for positively identifying each signal.

1.4 FACP: FIRE ALARM CONTROL PANEL.

A. Supervisory Signal: Indicates abnormal status or need for action regarding fire suppression or other protective system.

1. Trouble Signal: Indicates that a fault, such as an open circuit or ground, has occurred in the system.

2. Zone: Initiating device or combination of devices connected to a single alarm-initiating device circuit. (SLC) Zone for addressable systems refers to each identifiable, unique device address.

1.5 SYSTEM DESCRIPTION

A. General: Complete, zoned, noncoded, addressable, microprocessor-based fire detection voice evacuation and alarm system with manual and automatic alarm initiation and automatic broadcast of voice recorded emergency evacuation signals from a supervised fire alarm sound distribution system. Devices located outdoors shall be specifically designed for exterior service. Provide battery back-up based upon total load per NFPA 72. Alarm shall achieve a minimum of 80 db throughout occupiable spaces and meet ADA requirements.

B. Signal Transmission: Multiplex signal transmission dedicated to fire alarm service only.

C. Alarm Indication: By transmitting emergency voice messages, sounding weatherproof horns, and illumination of ADA strobes.

D. The fire alarm system shall allow for loading and editing special instructions and operation sequences as required. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.

E. The system shall have the capability of loading software operations from a single node to all other nodes on the network.

F. Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate future changes. For example, monitoring of normally open contact devices to monitoring of normally closed contact devices, or from sensing of normally open contact devices to sensing a combination circuit and being able to differentiate between the two.

G. Resident software shall allow for configuration of notification appliance and control circuits so that additional hardware shall not be necessary to accommodate changes. For example, changing a non-coded notification applicant circuit to a coded circuit; or from a slow march time (20 BPM) to fast march time (120 BPM) coding.

H. The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event history.

I. System connections and conduit and wiring for alarm indicating circuits: Style "Y" Wiring.

J. System connections and conduit and wiring for alarm-initiation circuits: Style "4 wiring.

1. Transmission to Remote Central Station: Provide wiring to automatically route an alarm, supervisory, and trouble signals to the building central station service transmitter located in main fire alarm control panel utilizing listed and approved equipment. Provide all necessary and required equipment, wiring and connections including digital communicator as required by this Contractor.

2. General Alarm: A system general alarm includes:

   a. Indicating the general alarm condition at the FACP and the integral annunciator.
   b. Identifying the device that is the source of the alarm at the FACP , and annunciator.
   c. Initiating audible (speakers) and visible alarm signals throughout the building.
   d. Stopping HVAC supply and return fans.
   e. Initiating transmission of alarm signal to remote central reporting station.
   f. Close fire/smoke doors.
   g. Initiate voice evacuation message broadcast.
   h. Close fire/smoke dampers.
   i. Shutdown all internal master Sound systems within the facility and dedicate the attention to the actual pre-recorded Fire Alarm message.
   j. Initiate and Control building Stair pressurization and smoke evacuation systems where required.

3. Manual station alarm operation initiates a general alarm.

4. Water-flow alarm switch operation: Initiates a general alarm.

5. Smoke or heat detection initiates a general alarm.

6. Elevator Lobby Detection: Activation of any elevator lobby (except the first-floor lobby), hoistway or machine room smoke detector shall initiate the elevator Phase I recall system to the affected elevator and initiate an alarm for the zone it is located within. Activation of the lobby smoke detector on the first floor shall send a separate signal to the elevator controller to send the car to the alternate fire department access level.

7. Elevator Machine Room Detection: The elevator machine room smoke detector shall energize a flashing warning light at the designated and alternate fire department access levels.

8. Elevator Shunt Trip: Activation of any elevator hoistway heat detector or the machine room heat detector shall initiate shunt trip of the affected elevator power supply, and by use of an auxiliary contact, initiate an alarm for the zone that it is located within. Provide all necessary interfaces and materials to connect to the shunt trip circuit of the elevator circuit breaker, and power mechanism. Utilize shunt trip power from the breaker controlled. Provide wiring system to the elevator controller for final connection by the elevator contractor. Provide supervision of the shunt trip circuit wiring at the FACP. Upon loss of circuit FACP shall annunciate loss of circuit by audible and visual alarms.

9. Elevator Alarm: Elevator lobby detectors shall be cross zoned, by means of software, to indicate an alarm in the zone covering the corridor where located and

indicate that the vertical elevator zone is in alarm as well.

1.6 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections. Contractor shall provide "too scale" complete Fire Alarm shop drawings to the Engineer and authority having jurisdiction for approval and permitting. All Fire Alarm drawings shall be signed and sealed by a State of Florida registered Engineer and shall be become the Engineer of record for the project.

B. Wiring diagrams from manufacturer differentiating between factory- and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Indicate components for both field and factory wiring. Indicate all overhead and underground wiring in conduit indicating all Style “4” and Style “Y” installations.

C. System operation description covering this specific Project including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.

D. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.

E. Record of field tests of system.

F. Load calculations for battery sizing.

G. Copy of warranty. Warranty shall reflect a minimum of (3) years on all manufactured equipment with one year warranty on all labor. Included shall be a written report of the complete test and Inspection of the system per NFPA-72. Report shall be completed within one month prior to the end of the one-year labor warranty. Documentation of this commitment shall be provided during the submittal process.

H. Copy of NFPA acceptable voice evacuation message.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A certified factory-trained technician is to perform the Work of this Section, making up all terminal cabinets, installing all surge suppressors, and including landing and testing each wire, mounting and connecting all devices, programming the main FACP, trouble shooting and certifying the final system. The Contractor shall be currently licensed by the State of Florida for Fire Alarm work and shall be a certified factory-trained technician. Contractor is responsible for obtaining all required and necessary fire alarm permits from the authority having jurisdiction.

B. Compliance With Local Requirements: Comply with the standard Building Code, All local ordinances, and regulations, and the requirements of the local jurisdiction.

C. Comply with State and Federal Americans with Disabilities Act (ADA) requirements.

D. Comply with NFPA 70, "National Electrical Code."

E. NFPA Compliance: Provide fire alarm and detection systems conforming to the requirements of the following publications:

1. NFPA 72, "National Fire Alarm Code."

2. American Disability Act (ADA).
3. NFPA 99 (Healthcare Code), Americans with Disabilities Act (ADA) ANSI A117.1, FGI Guidelines For the design and construction of patient care facilities, regulations of the Agency for Healthcare Administration (AHCA) 58a-5 and FC –Chapter 400.

F. NRTL Listing: Provide systems and equipment that are listed and labeled.

1. Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

G. FM Compliance: Provide fire alarm systems and components that are FM-approved.

H. Coordinate all wiring and device interfaces with the Owner's authorized representative.

I. Entire fire alarm system and all components shall have (3) year warranty from date of final Certificate of Occupancy (Not TCO).

J. Fire alarm devices and equipment to be installed outdoors in exterior locations shall be specifically designed and U.L. listed as weather and waterproof. Provide weatherproof Neoprene gaskets between wall mounting surface and fire alarm device for all devices mounted outdoors.

1.8 EXTRA MATERIALS

A. General: Furnish extra materials and labor and materials as required to install connect and test matching products installed (as described below). If not utilized the devices and equipment shall be packaged and sealed with protective covering for storage and identifying with labels clearly describing contents.

1.	Weatherproof speaker/strobes	(4) units
2.	Strobes	(4) units
3.	Weatherproof horn boxes	(2) units
4.	Manual pull stations	(6) units
5.	Smoke detectors and base	(6) units
6.	Heat detectors and base	(2) units
7.	Duct smoke detector	(3) units
8.	Addressable module each type	(3) units
9.	Relay devices module	(2) units
10.	Data surge suppressor	(2) units
11.	Signal circuit surge suppressor	(1) unit
12.	A/C 120v power surge suppressor	(1) unit
13.	Wall mounted combination strobe/speakers	(8) units
14.	Ceiling mounted combination strobe/speakers	(8) units

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: All devices shall be provided for and manufactured by Notifier, EST or Pyrotronics

2.2 MANUAL PULL STATIONS

A. Description: Double-action non-break glass, addressable type, fabricated of metal or plastic, and fin

ished in white with molded, raised-letter operating instructions of red color. Address of unit shall be field-settable without special tools.

B. Station Reset: Key-operated, to the FACP, double-pole, double-throw, switch-rated for the voltage and current at which it operates. Stations have screw terminals for connections.

2.3 SMOKE DETECTORS (PHOTO ELECTRIC)

A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:

1. Factory Nameplate: Serial number and type identification.
2. Operating Voltage: 24-V d.c., maximum.
3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
4. Plug-In Arrangement: Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs for secure mounting and contact maintenance. Terminals in the fixed base accept building wiring.
5. Visual Indicator: Connected to indicate detector has operated.
6. Addressability: Detectors include a communication transmitter and receiver having a unique identification and capability for status reporting to the FACP. Device shall contain an integral LED which shall flash each time the device is interrogated. Device shall be capable of field setting without special tools.
7. Provide dual contact where indicated.

B. Addressable Photoelectric Smoke Detectors: Include the following features and characteristics:

1. Detector Sensitivity: Devices shall have smoke density feature.
2. Sensor: An infrared detector light source with matching silicon cell receiver.

C. Addressable Duct Smoke Detector: Unit shall be photoelectric-type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Exterior units shall be specifically designed and U.L. approved for outdoor use or provide weatherproof enclosure. Provide unit with alarm indicator.

2.4 HEAT DETECTORS

A. Addressable Thermal Detector: Rate-compensated/fixed-temperature type with plug-in base and alarm indication lamp. Detectors have a communication transmitter and receiver with unique identification and capability for status-reporting to the FACP.

B. Field coordinate the exact location of heat detectors in mechanical spaces with ductwork as to provide unobstructed access to all fire alarm devices.

C. Provide 120-volt dual convertible contact rated devices where indicated.

2.5 ALARM-INDICATING DEVICES

A. General: Equip alarm-indicating devices for mounting as indicated. Provide terminal blocks for system connections.

B. Weatherproof Fire Alarm Horn: Electric Piezo, 24-V d.c. type. When operating, provide a sound p

ressure level of 90 dB (min), measured 10 feet from the horn. Provide flush-mounted, gasketed weatherproof and waterproof units specifically designed for outdoor use. Combination Audio/ Visual Alarm Devices shall mount on cover of Horn and share common weatherproof enclosure.

C. Addressable Interface Units: Arrange to monitor and/or control system components that are not otherwise equipped for multiplex communication. Units transmit identification and status to the FACP using a communication transmitter and receiver with unique identification and capability for status-reporting to the FACP. Provide separate 24-volt power conductors where required.

D. Visual Alarm Devices: A.D.A. approved strobe lights with clear polycarbonate lens and xenon flash tube. Mount lenses on an aluminum face plate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

1. Lamps have a minimum peak intensity of 75 candela unless otherwise noted to be higher. Strobe leads are factory-connected to screw terminals.
2. Combination devices consist of factory-combined, audible speaker and visual alarm units in a single mounting assembly.

E. Voice/Tone Speakers: Comply with UL 1480, “Speakers for Fire Protective Signaling”.

1. Speakers: 8” compression-driver type with flared projectors having a frequency response of 400 to 4000 Hz; equipped with a multiple tap, varnish-impregnated, sealed, matching transformer. Match transformer tap range and speaker power rating to the acoustical environment of the speaker location.
2. Low-Range Speaker Units: Rated .25-2 watts.
3. Speaker Mounting: Flush, ceiling mounted.
4. Provide backbox T-bar and white speaker grille.
5. Single range 70 db or 15 db above ambient.
6. Combination Strobe/Fire Projection Speaker: Unit shall be a flush wall-or ceiling mounted combination device incorporating an ADA 110 candela strobe device with the word “Fire” in white letters embossed on a tamper-resistant Lexan cover. The speaker shall be front-mounted with a 4” paper cone speaker completely enclosed within an impact, moisture-retardant and flame-retardant thermoplastic. The speaker shall be equipped with a matching transformer with multiple taps. Combination device shall be UL listed for fire alarm use.

2.6 FIRE ALARM CONTROL PANEL (FACP)

A. General: Comply with UL 864, “Control Units for Fire-Protective Signaling Systems".

B. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of units, as well as field wiring. Identify each enclosure by an engraved, red-laminated, phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1-inch high.

C. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in modules. Construction requiring removal of field wiring for module replacement is not acceptable.

D. Control Modules: Types and capacities required to perform all functions of the fire alarm systems. Local, visible, and audible signals notify of alarm, supervisory and trouble

conditions.

E. The fire alarm control panel (FACP) shall be an addressable and Networked Voice evacuation system with on board amplifiers. Provide complete system coordination with manufacturer's representative prior to bidding. The panel shall be completely compatible with the voice evacuation system and shall be UL listed as a completely integrated system.

F. Instructions: Provide a typewritten instruction card mounted behind a glass cover in a stainless-steel frame. Install the frame in a location observable from the FACP. Include interpretation and appropriate response for fire alarm displays and signals, and briefly describe the functional operation of the system under normal, alarm, and trouble conditions. A map shall also be provided indicating the rooms with initiation devices and their loop number and address number shown, matching the device address.

2.7 FACP EMERGENCY POWER SUPPLY

A. General: Components include valve-regulated, recombinant lead acid battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 10 years minimum. Battery and charger shall be provided by this contractor with strict coordination with the FACP manufacturer and Owner.

B. Alarm Silencing: If the "Alarm Silence" button is pressed, all alarm signals shall cease operation.

C. System Reset:

1. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS," "RESET COMPLETED") as they occur, should all alarm conditions be cleared.
2. Should an alarm condition continue, the system will remain in an alarmed state. System control relays shall not reset. The control unit alarm LED shall remain on. The alarmed points will not require acknowledgement if they were previously acknowledged.

D. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated. However, should an actual alarm occur, all alarm functions would occur as described previously.

E. Activation of an auxiliary bypass switch shall override the selected automatic functions.

F. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode.

G. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

H. Power Requirements

1. The control unit shall receive 120 VAC power via a dedicated fused disconnect circuit.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.

3. All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control unit.
4. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visibly indicated at the control unit.

2.8 WIRE/CABLE

A. Line-Voltage: Line voltage conductors shall be solid copper conductors with 600 V-rated insulation. #10-gauge, minimum adjusted for larger gauge long runs.

B. Initiation Circuits (Loop): Initiation loop conductors shall be West Penn #D991 for 3000'-0" in length and less. West Penn #D995 shall be used for circuits over 3000'-0" in length. Below grade, wet or damp location installed cable, including cable installed on the top of exterior walkways, shall be West Penn AQUASEAL multi-conductor (14 gauge), unless noted otherwise, shall be installed in conduit.

C. Signal Circuits: Signal circuits shall be #12 AWG THWN 19 strand copper.

D. Annunciator Circuits: #12 AWG THWN 19 strand copper.

E. Color Code: Color code shall be strictly adhered to:

		Positive	Negative
Audio/visual*	#12 AWG (THWN)	+orange	-white
E relay circuit	#14 AWG (THWN)	+pink	-black
Door holders	#14 AWG (THWN)	+gray	-black
Gas shutoff	#14 AWG (THWN)	+gray	-black
24 VDC	#14 AWG (THWN)	+red	-black
Automatic (nonaddressable)	#14 AWG (THWN)	+yellow	-brown
Manual (nonaddressable)	#14 AWG (THWN)	+blue	-purple
Fire Alarm Speaker Circuits	#18/2 TSP	black/white	

F. All wire shall be installed in new concealed conduit, minimum ½" conduit

G. All wire and cable shall meet requirements of NFPA 72 Rule 12.4.4.

2.9 TAGS

A. Tags For Identifying Tested Components: Comply with NFPA 72. All new and existing fire alarm junction boxes shall be painted bright red, including inside, outside and cover prior to installing conductors.

B. All indicating, monitoring, and control devices shall be labeled with its loop and address number permanently attached to the device in plain view. All labels shall be typewritten with an approved label maker utilizing protected coverings; hand labeling is not acceptable.

C. Each and every wire shall be labeled at each end with SLC #, channel # or signal #. Each separate circuit, initiation, signal and auxiliary shall have a specific number. Label each conductor by this circuit number at the control connections and at each terminal connection in the terminal cabinets.

2.10 SURGE SUPPRESSION

A. Provide complete signal, speaker data loop and power side surge suppression modules on all wiring entering or leaving the FACP or remote NAC panel. The Contractor shall repair any damaged components or wiring due to transient voltage surges for a period of one year from final completion date at no additional cost.

B. At the main FACP, install surge suppression devices in a separate lockable metal enclosure which is located directly adjacent to the main FACP. The cabinet shall match the FACP cabinet construction exactly. Utilize empty FACP terminal cabinet that matches the FACP cabinet exactly. Provide a #6 AWG ground wire on all surge suppressors to the individual building grounding electrode system. All signal, data, d/c power supply surge suppressors shall be Edco #PCH043 with base and hold-down connection clips. 120v A/C devices shall be Edco #HSP121BTRU. Contractor shall follow manufacturer's instructions for installing and connecting surge suppression devices exactly.

C. Telephone transmission line to UDACT dialer shall also have a surge suppression device installed and connected.

2.11 CONTROL RELAYS

A. Provide relays for other local control such as HVAC shutdown, roll-up door activation or fire/smoke damper release. Relays shall be 10 amp rated relays. Upon activation of the fire alarm system, the relay shall activate and shutdown the controlled equipment. Locate all relays within 36" of equipment controlled in an identified enclosure. Provide weatherproof units where indicated or install in weatherproof boxes.

2.12 SIGNAL EXPANDERS

A. Provide remote 9-amp audio/visual power supply and battery charger in a self-contained lockable cabinet. Provide (4) Style Y notification circuits, and an integral battery charger. Provide unit with integral 120-volt input A/C power and integral lead acid battery. Provide surge suppression for 120-volt branch circuit and provide a 20-amp 125 vac specification grade key type switch to control the power to the signal expander for maintenance. Identify the 120 volt circuit serving the switch (.i.e panelboard and branch circuit number).

2.13 REMOTE ANNUNCIATOR

A. Provide a flush mounted LCD type full function with fire fighter microphone remote annunciator at the front entry of the facility. Unit shall be no larger than 8" tall x 10" long and shall be completely flush mounted. The remote annunciator shall be full function and be capable of complete control from this location per AHCA requirements.

2.14 FIRE FIGHTER JACKS

A. Provide wiring in conduit for floor fireman outlet jacks. All plates shall be stainless steel and shall be accessible from a remote fireman's microphone. Install microphone outlets per FBC Chapter 900 section 907.2.12.3.

2.15 HVAC SHUTDOWN RELAYS

A. Operation: Provide a data addressable module at each air handling system and exhaust fan for shutdown on alarm from the fire alarm system as per the systems operation description. The unit shall be wired such that it shall be self-monitoring for integrity. A failure of the relay or associated wiring shall cause unit shutdown. The coil voltage of the relay shall match the fire alarm control panel voltage and a fire alarm signal shall initiate interruption of the air handling unit starting circuit.

2.16 DOOR HOLD OPEN DEVICES

A. Equipment: Devices as indicated on the drawings shall be as follows:

1. Door solenoid holder/closer header type 24 volt where required.
2. Two piece magnetic door and wall mount unit 24 volt where required.
3. Provide structural backing in to mount all devices.
4. Doors provided with Door Hold open devices shall have system smoke detectors installed on both sides of doorway per NFPA and FBC whether indicated or not.

2.17 ELEVATOR RECALL AND DETECTION SYSTEM

A. Installation: Contractor shall provide all conduits, wiring relays, controls and associated devices and detectors for Phase I and Phase II recall per Florida Building Code (FBC) requirements and State Elevator Inspector requirements.

2.18 REPEATER STATION /ANTENNA POWER CONNECTIONS

A. Contractor shall provide 120-volt power connections for future remote repeater stations and antenna locations in all areas per the drawing requirements and or as required by the code.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system according to NFPA Standards referenced in Parts 1 and 2 of this Section.

3.2 EQUIPMENT INSTALLATION

A. Manual Pull Stations: Mount semi-flush in recessed back boxes with operating handles as indicated. Devices shall be mounted at 48" above finished floor to the top of device. Provide weatherproof protective guards for devices located in exterior areas or locate addressable modules behind pull stations.

B. Smoke Detectors: Install ceiling-mounted detectors not less than 4 inches from a side wall to the near edge. Install detectors located on the wall at least 4 inches but not more than 12 inches below the ceiling. For exposed solid joist construction, mount detectors on the bottoms of the joists. On smooth ceilings, install detectors not over 30 feet apart in any direction. Install detectors no closer than 5 feet from air registers.

C. Audible/Visual Alarm-Indicating Devices: Install at 80 inches to the bottom of device, above the finished floor per ADA requirements. Install speakers or horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille or as indicated. Combine audible and visual alarms at the same location into a single unit.

D. Visual Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn or as a combination unit. Install at 80 inches to bottom of device per ADA requirements.

E. Fire Alarm Junction Boxes: Surface mount with tops of cabinets not more than 60 inches above the finished floor.

F. Coordinate location and final installation of duct smoke detectors with HVAC ductwork installation conditions. Installation of detectors shall be by this Contractor. Contractor shall install all duct smoke detectors in all accessible locations for maintenance.

SECTION 28 31 11 - TWO-WAY EMERGENCY COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Applicable requirements of Section 260000 - Electrical General shall be considered a part of this section and shall have the same force as if printed herein in full.

B. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and/or on the Drawings.

1.2 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to, the following:

1. Furnish and install communication base system, call boxes, graphics, labeling and all associated wiring.

1.3 QUALITY ASSURANCE

A. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the Specifications.

B. Components and installation shall be in accordance with the requirements of the Florida I Building Code, NFPA, and ADAAG.

1.4 SHOP DRAWINGS

A. Shop drawings shall be submitted and shall contain the following:

1. Specification sheet/sheets of technical data on each hardware component
2. Specification sheet(s) on wiring to be utilized
3. One-line schematic riser diagram made specifically for this job
4. Calculation for sizing batteries and power supplies
5. Sequence of operation for the entire system
6. Verification of central supervising station (UL Certified)
7. Equipment and service warranty
8. Scaled floor plans showing device locations and wire routing

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

A. Approved Two-Way Communication System Manufacturer

1. Rath Area of Refuge

2.2 SYSTEM COMPONENTS

A. The Base Station shall be installed in a constantly attended locations, main telephone room, or electrical room, and shall have the following components:

1. Stainless steel or powder-coated steel housing, red coil cord emergency Handset, 120vac powered, with battery back-up power for 4 hours operation of any call box and base station.
2. Audible and visual indicator that a call box has been activated.
3. 24vac power supply model capable of supplying power to a minimum of 40 call boxes.

B. Each Call Box shall be installed in location shown on the drawings, and shall have the following features:

1. Must comply with Americans with Disabilities Act (ADA)
2. Hands-free speakerphone with an LED to indicate status of call
3. Programmable for specific location message of the Call Box. This allows rescue personnel to know the location of the activated Call Box.
4. Braille faceplate located no higher than 48" for front reach and 54" for side reach above ground level to ensure conformance with the ADA requirements.

2.3 SYSTEM FEATURES

A. Operational Communication Features

1. Call Box shall be hands-free operable and be a push-button-once to talk system. Once the button has been pushed, the Call Box will call the Base Station. If no answer at the Base Station, it will automatically call preprogrammed emergency numbers. The Call Box must be capable of being programmed with up to 5 emergency numbers to activate two-way off-site person-to-person voice communications.
2. Call Box shall have Location Message capability. Call Box must have a minimum 18 second recordable message capability, programmable to play 1 or 2 times. Call Box shall notify called party of the location of the call upon being received at the emergency dispatch center.
3. Call Box shall be capable of allowing the called party to replay the Location Message if necessary to ensure an understanding of the caller location.
4. Once call has been made (button pushed), the call can be terminated only by the called party.
5. Call Box must have a red LED that will light up upon push of the button. The light shall be a solid color when the Call Box is activated and will flash when call has been answered.
6. Call Box must be capable of being programmed and reprogrammed on-site and remotely.
7. Operating temperature of call box shall be between -40 deg. F to 150 deg. F.
8. Call Box shall have EEPROM memory to protect programming.

B. Graphics and Labeling

1. Base Station shall have appropriate wording to indicate the location of each call box, located adjacent to the LED associated with each call box.
2. Call Box graphics must include “Help Phone,” international phone symbol and raised Braille lettering.

PART 3 - EXECUTION

3.1 MONITORING

A. Contractor shall coordinate with the owner to arrange for an off-site monitoring agency associated with this communication system.

3.2 CABLING

A. Cabling for two-way communication system shall meet the applicable requirements for pathway survivability. Cabling installation shall consist of one or more of the following:

1. 2-hour fire-rated circuit integrity (CI) cable
2. 2-hour fire-rated cable system
3. 2-hour fire-rated enclosure or protected area

3.3 TESTING

A. Prior to completion, contractor shall test the functionality of all call boxes, both for connection to the base station, as well as for successful communication with off-site monitoring agency.

3.4 WARRANTY

A. System shall be warranted for a period of three years.

END OF SECTION 28 31 11

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G. Install flush speaker complete with back box and speaker grille, and T-bar mounting supports.

3.3 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway. Conceal raceway except in unfinished spaces and as indicated.

B. Wiring Within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the wiring diagrams of the system. Make all connections with approved crimp on terminal spade lugs, pressure type terminal blocks, or plug connectors, utilizing approved tool specific for crimp on connections. Wire nut connections are unacceptable. Leave a minimum of 8" wire make-up length at each device and splice. Make up length shall be measured after device is connected or splice is made to front of box. Shields on “SLC” wire shall be made up, twisted together, and taped behind devices at all device locations. SLC drain wire located in FAJB’s and FACP shall be surge protected at the main fire alarm cabinet and at all other remote terminal cabinets and shall be terminated on a terminal strip.

E. Tee tap connections are strictly prohibited. No wire nut connections are acceptable in any location. No splices shall be installed in any fire alarm junction box except to that individual device.

D. No fire alarm conductors shall be installed below grade. All wiring shall be overhead installed in concealed conduit minimum 1/2”. No underground, on ground or underground splices in pull boxes will be allowed.

E. All terminal cabinets and terminations shall be above ground.

F. All conduits used or unused connected to FACP or FACP junction boxes shall be identified and labeled as to destination.

G. All junction boxes used for fire alarm shall be located a minimum of 12” and maximum of 36” from ceiling grid. Overhead junction boxes may not be installed where accessibility is dependent on removal of a lighting fixture or access cover. No junction box shall be located above drywall ceiling. All fire alarm devices and fire alarm device junction boxes’ locations shall be coordinated with all other trades such that all are accessible.

H. Mounting boxes for speakers/horn/strobes, control and monitor modules shall be installed in deep junction boxes with extension ring attached.

3.4 GROUNDING

A. Ground equipment surge suppression. For audio circuits, minimize to the greatest extent possible ground loops, common mode returns, noise pickup, cross talk, and other impairments. Measure, record, and report ground resistance. Provide a #6 AWG grounding conductor in concealed conduit from the individual building grounding electrode system to the FACP and each remote Fire Alarm terminal cabinet from the individual building grounding electrode system where cabinet is located. Terminate ground conductor on multi-conductor lug secured within the cabinet.

3.5 FIELD QUALITY CONTROL

A. Pretesting: Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications.

B. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

C. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.

D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72. Minimum required tests are as follows:

1. Verify the absence of unwanted voltages between circuit conductors and ground.
2. Megger test all conductors other than those intentionally and permanently grounded with electronic components disconnected. Test for resistance to ground. Report readings of less than 1-megohm for evaluation.
3. Test all conductors for short circuits utilizing an insulation-testing device.
4. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
5. Verify the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
6. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection should be opened at not less than 10 percent of the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
7. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
8. Test the system for all specified functions according to the manufacturer's operating and maintenance manual. Systematically initiate specified functional performance items at each station including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
9. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the period and in the manner specified.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.

H. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

3.6 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to five prepaid visits to the site for this purpose.

3.7 DEMONSTRATION

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel in the location of devices, boxes, procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 4 hours' training. Training shall include a complete project walk down with Owner's authorized representative to identify device locations, junction box locations and surge suppression module locations.
2. Schedule training with the Owner at least seven working days in advance.

END OF SECTION 28 30 00

SECTION 27 00 10 - SUPPLEMENTAL REQUIREMENTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 27.

B. Related Requirements:

1. Work specified in the following Division 26 sections are related to Work specified in Division 27:

a. Section 260010 "Supplemental Requirements for Electrical" for abbreviations and acronyms for electrical terms and units of measure, abbreviations and acronyms for electrical raceway types, abbreviations and acronyms for electrical cable types, definitions, and additional coordination drawing submittal requirements.
b. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work.

1.2 REFERENCES

A. Abbreviations and Acronyms for Communications:

1. LAN: Local area network.
2. PoE: Power over Ethernet.
3. POTS: Plain old telephone service. See "public switched telephone network."
4. TCP/IP: Transmission control protocol/Internet protocol.
5. WAN: Wide area network.

B. Definitions for Communications:

1. Calling Party Control (CPC): A momentary break in phone line loop current, which is used to signal voicemail and other automated telephone company services that distant party has hung up.
2. Private Branch Exchange (PBX): Analog telephone switch that routes calls internal to a business or organization so a direct external line for each phone is unnecessary.
3. Public Switched Telephone Network (PSTN): Analog telephone technology that uses twisted-pair cables from a telephone-provider central office for the transmission medium. PSTN refers to the telephone network; POTS refers to the individual subscriber line.
4. Remote Office Phone System (ROPS): VoIP system that allows phones for a business or organization located anywhere in the world with internet connectivity to behave similar to phones connected to a PBX.
5. Ringer Equivalence Number (REN): The loading effect of a single traditional telephone ringing circuit. TIA-968 defines REN as an impedance of 7000Ω at 20Hz (Type A ringer) or 8000Ω from 15Hz to 68Hz (Type B ringer). The sum of the RENs for all devices on a

subscriber line circuit may not exceed the maximum permitted REN for the subscriber line.

6. Voice over Internet Protocol (VoIP): Digital telephone packet technology that uses the internet for its transmission medium.

1.3 COORDINATION

1.4 PREINSTALLATION MEETINGS

A. Communications Preconstruction Conference: Schedule conference with Architect and Owner not later than [10] days after notice to proceed. Agenda topics include, but are not limited to, the following:

1. Installation schedule for communications systems.
2. Value analysis proposals and requests for substitution of communications equipment.
3. Utility services work coordination and monitoring service requests.
4. Commissioning activities.
5. Sustainability activities.

1.5 SCHEDULING

1.6 ACTION SUBMITTALS

A. Coordination Drawings: Submit multidiscipline coordination drawings depicting communications equipment, devices, cabling, conduit, and duct banks in accordance with requirements specified in division 26 specifications.

1.7 INFORMATIONAL SUBMITTALS

A. Installation schedule for communications systems.

B. Qualification statements.

C. Welding certificates.

D. Seismic-load performance certificates [and wind-load performance certificates].

1.8 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and firmware operational documentation.

C. Software.

1.9 QUALITY ASSURANCE

A. Qualifications: Prepare and submit qualification statements for the following entities performing Work on Project:

1. Qualified Regional Manufacturer: Manufacturer, possessing appropriate qualifications, maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than [eight hours]
2. Communications Design Professional: Design professional possessing active qualifications and the following:

a. Expertise in design of communications infrastructure and distribution equipment.
b. BICSI Registered Communications Distribution Designer (RCDD) [or Outside Plant Designer (OSP)] certification.

3. Communications Cable Installer: Entity possessing active qualifications and the following:

a. Training and manufacturer certification to install, splice, and terminate communications cabling.
b. Installation Supervisor: BICSI Technician (TECH) certification.
c. Copper Installers: [30 percent] of employees possess BICSI Copper Installer#2 (INSTC) certification. Remaining employees possess BICSI Installer 1 (INST1) certification.
d. Fiber Installers: [30 percent] of employees possess BICSI Optical Fiber Installer#2 (INSTF) certification. Remaining employees possess BICSI Installer#1 (INST1) certification.

4. Communications Cable Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.

a. On-site communications cable testing supervisor must have [BICSI Technician (TECH)] certification and documented training and be experienced with testing communications equipment in accordance with [BICSI] testing standards.

5. Structural Testing and Inspecting Agency: Entity possessing active qualifications with documented training and experience with testing structural concrete, seismic controls, and wind-load controls.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR COMMUNICATIONS EQUIPMENT

A. Substitution requests for communications equipment will be entertained under the following conditions:

1. Notification of Contractor's intent to request substitutions for convenience must be declared during the Communications Preconstruction Conference so potential risks to system performance and construction schedule may be identified for Contractor's response in submission of the substitution request.
2. For communications equipment and systems, substitutions for cause are considered major construction risks. If it is possible that Contractor may need to request substitutions for cause because of equipment unavailability, or inability to meet construction schedule because of lead time, Contractor must declare the possibility during the Communications

Preconstruction Conference to permit establishing a mitigation plan for minimizing risks to system performance and construction schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Contractor to perform site survey to coordinate existing conditions with installation procedures and best practices prior to installation.

B. Preinstallation Testing:

1. Contractor shall prove testing equipment has been calibrated and meets current standards for performing such work.

C. Evaluation and Assessment:

1. Contractor shall provide test results post installation that provide proof of system performance and describe any deviations from initial site survey findings.

3.2 PREPARATION

A. Installation Schedule for Communications Systems: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for installation of communications Work to Owner and Architect including, but not limited to, milestone dates for the following activities:

1. Submission of specified coordination drawings.
2. Submission of action submittals specified in Division#27.
3. Orders placed for major equipment.
4. Arrival of major equipment on-site.
5. Preinstallation meetings specified in Division#27.
6. Telephone and internet service outages.
7. Telephone and internet service inspection and activation.
8. Mockup reviews.
9. Closing of walls and ceilings containing communications Work.
10. System startup, testing, and commissioning activities for communications equipment.
11. System startup, testing, and commissioning activities for Work specified in other divisions that depends on Work specified in Division#27.
12. System startup, testing, and commissioning activities for automation systems (for example, SCADA, BMS, lighting, HVAC, fire alarm, fire pump).
13. Requests for special inspections.
14. Requests for inspections by authorities having jurisdiction.

3.3 INSTALLATION OF COMMUNICATIONS WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' instructions, comply with NFPA#70, NECA#NEIS#1, and BICSI#1 for installation of Work specified in Division#27. Consult Architect for resolution of conflicting requirements.

3.4 FIELD QUALITY CONTROL

A. Administrant for Communications Tests and Inspections:

1. Engage qualified communications cable testing and inspecting agency to administer and perform tests and inspections.

B. Administrant for Structural Tests and Inspections:

1. Engage qualified structural testing and inspecting agency to administer and perform tests and inspections.

3.5 CLOSEOUT ACTIVITIES

A. Operation and Maintenance Data: Prepare and submit the following:

1. Include emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:
   a. Access Control System
   b. Surveillance (CCTV) System
   c. Voice/Data Network Equipment
   d. Nurse Call System
   e. Paging System

2. Include the following information:

   a. Manufacturer's operating specifications.
   b. User's guides for software and hardware.
   c. Schedule of maintenance material items recommended to be stored at Project site.
   d. Detailed instructions covering operation under both normal and abnormal conditions.
   e. Manufacturer's instructions for setting field-adjustable components.
   f. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
   g. Include copies of demonstration and training videos.

B. Software and Firmware Operational Documentation: Provide software and firmware operational documentation, including the following:

1. Software operating and upgrade manuals.
2. Names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.
5. Testing and adjusting of panic and emergency communications features.

C. Demonstration:

1. With assistance from factory-authorized service representatives, demonstrate to Owner's maintenance and clerical personnel and building occupants how to operate the following systems and equipment:

a. Nurse-call equipment specified in Section#275223 "Nurse Call/Code Blue Systems."
b. Public address systems specified in Section#275116.

D. Training:

1. With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:

a. How to adjust, operate, and maintain public address system equipment specified in Section#275116 "Public Address System."
b. How to adjust, operate, and maintain intercommunications and program system equipment specified in Section#275123.20 "Commercial Intercommunications and Program Systems," including programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment.
c. How to adjust, operate, and maintain intercommunications and program system equipment specified in Section#275123.50 "Educational Intercommunications and Program Systems," including programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment.
d. How to adjust, operate, and maintain nurse-call equipment specified in Section#275223 "Nurse Call/Code Blue Systems."
e. How to adjust, operate, and maintain clock and program-control system components specified in Section#275313 "Clock Systems."
f. How to adjust, operate, and maintain Access Control system components specified in Section#281000 "Access Control Software and Database Management."
g. How to adjust, operate, and maintain Video Surveillance system components specified in Section#282000 "Video Surveillance."

END OF SECTION 27 00 10

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SECTION 27 05 28 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type OFR and Type CR communications raceways and fittings.
2. Cable support and positioning devices.

B. Related Requirements:

1. Section 270010 "Supplemental Requirements for Communications" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project
2. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding conductors and connectors for communications pathways installed by this Section.
3. Section 260533.13 "Conduits for Electrical Systems" specifies the following installed by this Section:

    a. Type EMT-A and Type EMT-SS duct raceways and elbows.
    b. Type EMT-S duct raceways and elbows.
    c. Type ENT duct raceways and fittings.
    d. Type HDPE and Type EPEC duct raceways and fittings.
    e. Type ERMC-A and Type ERMC-SS duct raceways, elbows, couplings, and nipples.
    f. Type ERMC-S duct raceways, elbows, couplings, and nipples.
    g. Type FMC-S and Type FMC-A duct raceways.
    h. Type FMT duct raceways.
    i. Type IMC duct raceways.
    j. Type LFMC duct raceways.
    k. Type LFNC duct raceways.
    l. Type PVC duct raceways and fittings.
    m. Type RTRC-AG duct raceways and fittings.
    n. Type RTRC-BG duct raceways and fittings.
    o. Fittings for conduit, tubing, and cable.
    p. Electrically conductive corrosion-resistant compounds for threaded conduit.
    q. Solvent cements.

4. Section 260533.16 "Boxes and Covers for Electrical Systems" specifies the following installed by this Section:

    a. Metallic outlet boxes, device boxes, rings, and covers.
    b. Nonmetallic outlet boxes, device boxes, rings, and covers.
    c. Junction boxes and pull boxes.
    d. Cover plates for device boxes.

e. Hoods for outlet boxes.

5. Section 260533.23 "Surface Raceways for Electrical Systems" specifies the following installed by this Section:

a. Surface metal raceways and fittings.
b. Surface nonmetallic raceways.
c. Strut-type channel raceways and fittings.
d. Wireways and auxiliary gutters.

6. Section 260553 "Identification for Electrical Systems" specifies labels and warning signs for communications pathways installed by this Section.

1.2 ACTION SUBMITTALS

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

a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

PART 2 - PRODUCTS

2.1 TYPE OFR AND TYPE CR COMMUNICATIONS RACEWAYS AND FITTINGS

A. Description: This product group covers raceways and fittings for installation of conductive and nonconductive optical-fiber cable, communications cable, power-limited fire-alarm cable, signaling cable, and coaxial cable in accordance with NFPA 70.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
2. Listing Criteria:

a. Optical-Fiber Cable Raceway: UL CCN QAZM; including UL 2024.
b. Communications Cable Raceway: UL CCN QBAA; including UL 2024.

C. UL QAZM - Type OFR-GP General-Purpose Optical-Fiber Raceway
1. Product Characteristics:

a. Texture: Smooth.
b. Splicing: Fusion

2. Required Product Options:

a. Colors:

1) For Optical Fiber: Yellow
2) For Coaxial Cable: Black or White
3) For Communications: Blue or Green
4) For Signaling: Other

D. UL QAZM - Type OFR-P Plenum Optical-Fiber Raceway

1. Panduit, CommScope or equivalent.
2. Product Characteristics:

a. Meets UL 2024 test requirements for "PLENUM" marking.
b. Texture: Smooth
c. Splicing: Fusion.

E. UL QAZM - Type OFR-R Riser Optical-Fiber Raceway

a. Texture: Smooth.
b. Splicing: Fusion

2. Required Product Options:

a. Couplings and Fittings:

b. Colors:

1) For Optical Fiber: Yellow
2) For Coaxial Cable: Black or White
3) For Communications: Blue or Green
4) For Signaling: Other

F. UL QBAA - Type CR-GP General-Purpose Communications Cable Raceway

1. CommScope or Panduit
2. Product Characteristics:

a. Texture: Smooth.
b. Splicing: Fusion

G. UL QBAA - Type CR-P Plenum Communications Cable Raceway

1. Panduit, CommScope or equivalent
2. Product Characteristics:

a. Meets UL 2024 test requirements for "PLENUM" marking.
b. Texture: Smooth or Ribbed
c. Splicing: Fusion

H. UL QBAA - Type CR-R Riser Communications Cable Raceway

1. Panduit, CommScope or equivalent.
2. Product Characteristics:

a. Meets UL 2024 test requirements for "RISER" marking.
b. Texture: Smooth
c. Splicing: Fusion

2.2 CABLE SUPPORTS AND POSITIONING DEVICES

A. Description: This category covers straps, hooks, and similar types of hardware for installation and use in communications cabling systems in accordance with NFPA 70 and manufacturer's installation instructions

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

C. UL#DWMU - J-Hook or G-Hook Cable Support:

1. Cablofil
2. Product Listing Criteria: UL CCN DWMU; including UL 2239 or UL 1565.
3. Product Characteristics:

a. Material: stainless steel.

D. UL DWMU - Conduit or Cable Support Strap :
1. Product Listing Criteria: UL CCN DWMU; including UL 2239 or UL 1565.

2. Required Product Options:

a. Suitable for use in air-handling space.

E. UL ZODZ - Cable Tie or Management System

F.
1. Product Listing Criteria: UL CCN ZODZ; including UL 62275.

2. Product Characteristics:

a. Classification: Type 2
b. Bundle Capacity: 80%
c. Mechanical Strength: 220 N
d. UL 746B Maximum Temperature Rating: 150 deg C.
e. Minimum Installation Temperature: Minus 60 deg C.
f. Fixing Device: Integral assembly or Adhesive securement.

3. Required Product Options:

a. UL 2043 Air-Handling Spaces Rating: AH-1 metallic components, AH-2 nonmetallic or composite components.

G. UL ZODZ - Cable Clamp, Clip, or Mount Positioning Device:

1. Product Listing Criteria: UL CCN ZODZ; including UL 1565.

2. Product Characteristics:

a. Materials: Metallic or Composite.
b. Bundle Capacity: 80%
c. Mechanical Strength: Greater than 18 kg , up to 23 kg-34 kg
d. UL 746B Maximum Temperature Rating: 150 deg C,

3. Required Product Options:

a. Fixing Device: Adhesive securement or with mechanical fastener.
b. Resistant to ultraviolet light.
c. Resistant to corrosion.
d. UL 2043 Air-Handling Spaces Rating: AH-1 metallic components or AH-2 nonmetallic or composite components.

PART 3 - EXECUTION

3.1 SELECTION OF PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.

B. Type OFR and Type CR Communications Raceways: Comply with Table 800.154(b) of NFPA 70.

C. Minimum Pathway Size:

1. For Copper and Aluminum Cables: trade size ¾”.
2. For Optical-Fiber Cables: trade size 1”.

D. Maximum Pathway Length Between Cable Access Points: 75 ft.

E. Temperature Limitations:

1. Type PVC, Type HDPE, Type EPEC, Type OFR, and Type CR: Do not install where ambient temperature exceeds 122 deg F (50 deg C). Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
2. Type RTRC: Do not install where ambient temperature exceeds 230 deg F.

F. Outdoor Pathways:

1. Exposed and Subject to Severe Physical Damage: ERMC

2. Exposed and Subject to Physical Damage: ERMC, IMC or Corrosion-resistant EMT.

   a. Locations less than 8 ft above finished floor.

3. Exposed and Not Subject to Physical Damage: ERMC, IMC, Corrosion-resistant EMT, PVC-80, RTRC-AG, LFMC, LFNC.
4. Concealed Aboveground: ERMC, IMC, EMT, PVC-80, PVC-40, RTRC-AG, LFMC, LFNC.
5. Direct Buried: PVC-80,PVC-40,HDPE-80,HDPE-40,RTRC-BG,LFMC,LFNC.
6. Concrete Encased Not in Trench: PVC-80, PVC-40, PVC-A,RTRC-BG,LFNC.
7. Concrete Encased in Trench: PVC-80, PVC-40, PVC-A],PVC-EB, HDPE-80, HDPE-40, EPEC-A, EPEC-B, RTRC-BG, LFNC.
8. Innerducts inside Other Raceway: ENT, RTRC-AG, RTRC-BG,OFR,CR.

G. Indoor Pathways:

1. Hazardous Classified Locations: IMC.
2. Exposed and Subject to Severe Physical Damage: IMC. Locations include the following:

   a. Mechanical rooms.

3. Exposed and Subject to Physical Damage: IMC. Locations include the following:

   a. Locations less than 8 ft above finished floor.
   b. Stub-ups to above suspended ceilings.

4. Exposed and Not Subject to Physical Damage: EMT or Cable tray.
5. Concealed above Suspended Ceilings: Cable tray or Hooks.
6. Concealed in Ceilings and Interior Walls and Partitions: IMC
7. Damp or Wet Locations: Corrosion-resistant EMT
8. Innerducts inside Metal Raceway: ENT
9. Exposed to Environmental Air: PVC-80
10. In Vertical Runs: IMC

H. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: Provide threaded-type fittings unless otherwise indicated.

I. Surface Raceways: Where indicated on Drawings.

J. Cable Supports and Positioning Devices:

1. Size hooks to allow minimum of 25 percent future capacity without exceeding design capacity limits.
2. Support hooks directly from building structure. Do not use ceiling grid support rods or wires.
3. Hook spacing must allow no more than 6 inch of slack. Lowest point of cables must be no closer than 6 inch to ceiling tiles, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 ft on center.
5. Provide hook at each change in direction.

K. Boxes and Enclosures:

1. Outdoors, Aboveground: UL 50E Type 3R.
2. Indoors: UL 50E Type 1, except use Type 4 stainless steel units in institutional kitchens and damp or wet locations.

L. Identification of Underground Pathways, Handholes, and Structures:

1. Use "COMMUNICATIONS" for legend on warning planks, underground warning tape, and covers.

3.2 SELECTION OF GROUNDING AND BONDING PRODUCTS

A. Grounding and Bonding Conductors:

1. Communications Busbar Connections:

a. TBC: Not smaller than 3/0 AWG and no smaller than largest TBB.
b. TBB: Not smaller than 2 kcmil per linear ft of conductor length, but not larger than 750 kcmil, unless otherwise indicated on Drawings.
c. BBC: Not smaller than largest TBB to which it is connected unless otherwise indicated on Drawings.
d. TEBC: Not smaller than 2 AWG unless otherwise indicated on Drawings. Provide bolted connectors.
e. UBC: Not smaller than 6 AWG unless otherwise indicated on Drawings. Provide bolted connectors.
f. Bonding Conductors to Structural Steel: Not smaller than 6 AWG unless otherwise indicated on Drawings. Provide bolted clamp connectors.

2. Cable Tray Connections:

a. Cable Tray Equipment Grounding Conductor: 6 AWG.
b. Cable Tray Bonding Jumper: If not supplied by cable manufacturer, provide bonding jumper not smaller than 10 AWG and not longer than 12 inch. If jumper is wire, it must be terminated with lug having two holes and long barrel for two crimps. If jumper is flexible braid, it must be terminated with one- or two-hole ferrule. Attach with bonding screw or connector provided by cable tray manufacturer.

3. Underground Connections: Not smaller than 2 AWG. Provide welded connectors, except bolted connectors may be used in handholes or manholes and as otherwise indicated on Drawings.

3.3 SELECTION OF COLORS AND IDENTIFICATION MARKINGS

A. Comply with 29 CFR 1910.144 for color identification of hazards, and the following:

1. Fire-protection and fire-alarm equipment**,** including raceways**,** must be finished, painted, or suitably marked safety red.

2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.

B. Pipe and Conduit Labeling: Comply with ASME A13.1.

C. Color Coding Scheme for Communications Cable and Terminations: Comply with BICSI N1 and TIA-598.

D. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:

1. "COMMUNICATIONS."
2. "FIRE ALARM."
3. "SECURITY."

Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

E. Locations of Underground Lines: Underground-line warning tape for communication, control wiring, and optical-fiber cable.

F. Communications Vaults, Manholes, Handholes, and Pull and Junction Boxes: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.

H. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with conductor designation.

I. Conductors To Be Extended in Future: Attach marker tape to conductors.

J. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

K. Equipment Identification Labels:

1. Black letters on white field.
2. Indoor Equipment: Baked-enamel signs.
3. Outdoor Equipment: Laminated acrylic or melamine sign.
4. Equipment To Be Labeled:

a. Racks, Frames, and Enclosures: Identify front and rear of each enclosure with self-adhesive labels containing equipment designation.
b. Patch Panels: Label individual rows in each rack, starting at top and working down, with self-adhesive labels.

c. Communications cabinets.
d. Access doors and panels for concealed communications items.
e. Emergency system boxes and enclosures.
f. Contactors.
g. Remote-controlled switches, dimmer modules, and control devices.
h. Monitoring and control equipment.
i. Fire-alarm equipment.
j. Security equipment.
k. Life-safety communications equipment.

L. Backbone Cables: Label each cable with a vinyl-wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.

M. Horizontal Cables: Label each cable with a vinyl-wraparound label.

N. Cover Plates: Label individual cover plates with self-adhesive labels. Place label at top of cover plate. Identify cover plate in accordance with TIA-606.

O. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.4 SELECTION OF SIGNS AND HAZARD MARKINGS

A. Comply with 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs.

B. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

C. Electrical Hazard Warnings:

1. Multiple Power Sources Warning Legend: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT/RACK HAS MULTIPLE POWER SOURCES."

D. Operating Instruction Signs: Self-adhesive labels.

3.5 INSTALLATION OF PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. Comply with manufacturers' published instructions, including limitations on distance, bends, and bend radius.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Type OFR Optical-Fiber Raceways: Article 800 of NFPA 70 and BICSI N1.
2. Type CR Communications Raceways: Article 800 of NFPA 70 and BICSI N1.
3. Cable Supports and Positioning Devices: Article 800 of NFPA 70 and BICSI N1.
4. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Complete communications raceway installation before starting conductor installation.
2. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.
3. Provide hangers and supports for pathways, boxes, and enclosures.
4. Firestop pathway penetrations of fire-rated assemblies.
5. Identification:

a. Provide colors and labels for pathways, boxes, enclosures, and associated communications equipment as indicated on Drawings.

b. Provide safety warning signs.
c. Bury underground warning tape approximately 12 inch above direct-buried conduits, but minimum of 6 inch below grade. Align tape along centerline of conduit.

D. Interfaces with Other Work:

1. Grounding and Bonding: Bond metallic communications boxes and enclosures to metallic pathways. Coordinate with Section 271100 "Communications Equipment Room Fittings" for grounding and bonding of communications pathways to communications equipment room fittings.
2. Coordinate with other trades for physical space and required clearances.

3.6 PROTECTION

A. Protect coatings and finishes of pathways, boxes, and enclosures 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 27 05 28

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SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Communications-circuit accessories.

B. Products Installed, but Not Furnished, under This Section:

1. Section 061000 "Rough Carpentry" furnishes equipment backing panels installed by this Section.
2. Section 260526 "Grounding and Bonding for Electrical Systems" furnishes the following installed by this Section:

    a. Grounding and bonding conductors.
    b. Grounding and bonding clamps.
    c. Grounding and bonding bushings.
    d. Grounding and bonding hubs.
    e. Grounding and bonding connectors.
    f. Intersystem bonding bridge grounding connector.
    g. Grounding and bonding busbars.
    h. Signal reference grids.

3. Section 260533.16 "Boxes and Covers for Electrical Systems" furnishes the following installed by this Section:

    a. Metallic outlet boxes, device boxes, rings, and covers.
    b. Junction boxes and pull boxes.
    c. Cover plates for device boxes.

4. Section 260553 "Identification for Electrical Systems" furnishes labels and warning signs for communications pathways installed by this Section.
5. Section 262726.39 "Locking Receptacles" furnishes locking receptacles installed by this Section.
6. Section 262726.51 "Connectors, Cords, and Plugs" furnishes pendant flexible cords and connectors installed by this Section.

C. Related Requirements:

1. Section 270010 "Supplemental Requirements for Communications" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 270528 "Pathways for Communications Systems" for installation of cable pathways serving communications equipment room fittings installed under this Section.

1.2 DEFINITIONS

A. PBB: Primary bonding busbar; located in main distribution frame room, ideally near electrical service entrance.

B. RBB: Rack bonding busbar; located in equipment cabinets and racks.

C. SBB: Secondary bonding busbar; located in intermediate distribution frame rooms.

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Communications equipment room drawings, diagrams, and supporting documents.

PART 2 - PRODUCTS

2.1 COMMUNICATIONS-CIRCUIT ACCESSORIES

A. Description: This category covers devices intended for connecting communications circuits in accordance with Article 800 of NFPA 70.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
2. Listing Criteria:

a. For Communications Circuits: UL CCN DUXR; including UL 1863 and UL 467.
b. For Audio/Video, Data, and Signaling Circuits: UL CCN DUXR; including UL 1977 and UL 467.

C. UL DUXR - 66-Style or 110-Style Cross-Connect Frame :
1. Fluke Networks or similar.
2. Options:

a. Connection Method: Punch down 8P8C Ethernet jack

D. UL DUXR - Patch Panel :
1. Tripplite
2. Options:

a. Distribution Port Quantity: [48] Port
b. Cable Type: [Cat. 6] ;[Cat. 6a].
c. Mounting: Equipment rack or Wall.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:

1. Communications Equipment Room Drawings, Diagrams, and Supporting Documents:

a. Include plans, elevations, sections, details, and attachments to other work.
b. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Equipment Racks and Cabinets: Indicate workspace requirements and access for cable connections.
d. Switchboards, Panelboards, and Safety Switches: Indicate workspace requirements and access for cable connections.
e. Grounding and Bonding: Indicate location of busbars and their mounting details showing standoff insulators and wall mounting brackets.
f. Cable Trays, Large Raceways, Ducts, and Piping: Indicate elevation and route of vertical and horizontal cable trays, raceways or ducts larger than 2 inch (50 mm) wide, and fire-suppression piping located inside communications equipment room.
g. Luminaires: Indicate elevation, orientation, and size of luminaires inside the communications equipment room for coordination with cable trays, equipment racks, cabinets, and other equipment.
h. Access Panels: Indicate locations, dimensions, and clearances required to open access panels in ducts, walls, or ceilings inside communications equipment room.
i. Controls: Indicate locations of sensors, switches, and push-buttons for HVAC, fire suppression, fire alarm, and standby power.
j. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
k. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
l. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

B. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.2 FIELD-FABRICATION OF FITTINGS FOR MAIN DISTRIBUTION FRAME ROOM OR SPACE

A. Description: Main distribution frame room or space usually contains demarcation point for communications service provider with central servers and communications equipment distributing to entire facility.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Designated Critical Operations Areas: Comply with Article 708 of NFPA 70.

2. Communications Systems: Comply with Ch. 8 of NFPA 70 and with BICSI N1.
3. Grounding and Bonding: Comply with Article 250 of NFPA 70 and with BICSI N3.
4. Consult Architect for resolution of conflicting requirements.

C. Provide the following specified products in main distribution frame room or space:

1. Quantity as indicated on Drawings equipment backing panel

   a. Install from 6 inch to 8 ft, 6 inch above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.

2. Quantity as indicated on Drawings of PBB
3. Quantity as indicated on Drawings of isolated ground, extra-heavy-duty, NEMA 5-20R duplex straight-blade receptacle, outlet box, and cover plate
4. Quantity as indicated on Drawings of [NEMA L5-20R] [isolated ground,] locking receptacle, outlet box, and cover plate .
5. Quantity as indicated on Drawings of NEMA L5-20R, pendant, extra-hard-usage, jacketed, flexible cord and connector .
6. Quantity as indicated on Drawings of surface-mounted multi-outlet assembly .
7. Quantity as indicated on Drawings of indoor service pole
8. Quantity as indicated on Drawings of [23 inch open] equipment rack with RBB and enclosure-mounted relocatable power tap .
9. Quantity as indicated on Drawings of 110-style cross-connect frame .
10. Quantity as indicated on Drawings of patch panel .

3.3 FIELD-FABRICATION OF FITTINGS FOR INTERMEDIATE DISTRIBUTION FRAME ROOMS OR SPACES

A. Description: Intermediate distribution frame room or space usually contains servers and communications equipment distributing to single zone or floor of facility.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Designated Critical Operations Areas: Comply with Article 708 of NFPA 70.
2. Communications Systems: Comply with Ch. 8 of NFPA 70 and with BICSI N1.
3. Grounding and Bonding: Comply with Article 250 of NFPA 70 and with BICSI N3.
4. Consult Architect for resolution of conflicting requirements.

C. Provide the following specified products in intermediate distribution frame room or space:

1. Quantity as indicated on Drawings equipment backing panel .

   a. Install from 6 inch to 8 ft, 6 inch above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.

2. Quantity as indicated on Drawings of SBB .
3. Quantity as indicated on Drawings of isolated ground, extra-heavy-duty, NEMA 5-20R duplex straight-blade receptacle, outlet box, and cover plate.
4. Quantity as indicated on Drawings NEMA L5-20R locking receptacle, outlet box, and cover plate .

5. Quantity as indicated on Drawings NEMA L5-20R pendant, extra-hard-usage, jacketed, flexible cord and connector .
6. Quantity as indicated on Drawings of surface-mounted multi-outlet assembly .
7. Quantity as indicated on Drawings of indoor service pole .
8. Quantity as indicated on Drawings of [23 inch open] equipment rack with RBB and enclosure-mounted relocatable power tap .
9. Quantity as indicated on Drawings of 110-style cross-connect frame .
10. Quantity as indicated on Drawings of patch panel .

11. Fire-Alarm Systems: Comply with NFPA 72 and Article 760 of NFPA 70.
12. Consult Architect for resolution of conflicting requirements.

END OF SECTION 27 11 00

SECTION 27 13 13 - COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backbone communications cables.
2. Communications-, audio/video-, data-, and other signaling-circuit accessories.

B. Products Installed, but Not Furnished, under This Section:
1. See Section 271513 "Communications Copper Horizontal Cabling" for Type CM, CMG, and CMX cabling.

C. Related Requirements:
1. Section 270010 "Supplemental Requirements for Communications" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 SEQUENCING

A. Wet-work in spaces must be completely dry, and HVAC system must be operating and maintaining ambient temperature and humidity conditions within manufacturer's recommended limits, before delivering and installing cables and connecting materials.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Backbone communications cable.
2. Communications-, audio/video-, data-, and other signaling-circuit accessories.

B. Shop Drawings:

1. Cable labeling schedules.
2. Cabling administration diagrams.
3. Wiring diagrams.
4. Cross-connect and patch panel details.
5. Twisted-pair cable testing plan.

C. Field quality-control reports.

D. Sustainable design submittals.

1. Backbone communications cable.

SECTION 27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type OFNR optical fiber cable.
2. Type OFCR optical fiber cable.
3. Type OFNP optical fiber cable.
4. Type OFCP optical fiber cable.
5. Types OFN and OFNG optical fiber cable.
6. Types OFC and OFCG optical fiber cable.
7. Optical fiber cable hardware.

1.2 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings:

1. System Labeling Schedules:

a. Electronic copy of labeling schedules, in software and format selected by Owner.

2. Cabling administration drawings and printouts.
3. Wiring diagrams showing typical schematic arrangement, including the following:

a. Telecommunications rooms plans and elevations.
b. Telecommunications pathways.
c. Telecommunications system access points.
d. Telecommunications grounding system.
e. Cross-connects.
f. Patch panels.
g. Patch cords.

4. Cross-Connect and Patch-Panel Drawings: Detail mounting assemblies and show elevations and physical relationship between installed components.

C. Field Quality-Control Submittals:

1. Optical fiber cable testing plan.
2. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Source Quality-Control Submittals:

1. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For optical fiber cable, splices, and connectors.

PART 2 - PRODUCTS

2.1 TYPE OFNR OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for use as risers in vertical runs in shaft or between floors within buildings in accordance with Article 770 of NFPA 70 containing no electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.
b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch.

C. Type OFNR, Designation OM1, Multimode Optical Fiber Cable

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAA; 62.5 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 200 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

D. Type OFNR, Designation OM2, Multimode Optical Fiber Cable

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

E. Type OFNR, Designation OM3, Multimode Optical Fiber Cable:

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAC; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 1500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 2000 MHz-km at 850 nm wavelength.

F. Type OFNR, Designation OM4, Multimode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAD; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 3500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 4700 MHz-km at 850 nm wavelength.

G. Type OFNR, Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

H. Type OFNR, Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

2.2 TYPE OFCR OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for use as risers in vertical runs in shaft or between floors within buildings in accordance with Article 770 of NFPA 70 containing noncurrent-carrying electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.
b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch.

C. Type OFCR, Designation OM1, Multimode Optical Fiber Cable:

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAA; 62.5 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 200 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

D. Type OFCR, Designation OM2, Multimode Optical Fiber Cable:

1. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

E. Type OFCR, Designation OM3, Multimode Optical Fiber Cable:

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAC; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 1500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 2000 MHz-km at 850 nm wavelength.

F. Type OFCR, Designation OM4, Multimode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAD; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 3500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 4700 MHz-km at 850 nm wavelength.

G. Type OFCR, Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable:

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

H. Type OFCR, Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable:

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

2.3 TYPE OFNP OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for use in vertical runs in plenums, ducts, or other spaces used for environmental air within buildings in accordance with Article 770 of NFPA 70 containing no electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.
b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.

2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).

C. Type OFNP, Designation OM1, Multimode Optical Fiber Cable:

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAA; 62.5 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 200 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

D. Type OFNP, Designation OM2, Multimode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

E. Type OFNP, Designation OM3, Multimode Optical Fiber Cable:

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAC; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 1500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 2000 MHz-km at 850 nm wavelength.

F. Type OFNP, Designation OM4, Multimode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAD; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 3500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 4700 MHz-km at 850 nm wavelength.

G. Type OFNP, Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

H. Type OFNP, Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

2.4 TYPE OFCP OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for use in vertical runs in plenums, ducts, or other spaces used for environmental air within buildings in accordance with Article 770 of NFPA 70 containing noncurrent-carrying electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.
b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).

C. Type OFCP, Designation OM1, Multimode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAA; 62.5 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 200 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

D. Type OFCP, Designation OM2, Multimode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

E. Type OFCP, Designation OM3, Multimode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

    a. Construction: TIA-492AAAC; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
    b. Minimum Overfilled Modal Bandwidth-Length Product: 1500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
    c. Minimum Effective Modal Bandwidth-Length Product: 2000 MHz-km at 850 nm wavelength.

F. Type OFCP, Designation OM4, Multimode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

    a. Construction: TIA-492AAAD; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
    b. Minimum Overfilled Modal Bandwidth-Length Product: 3500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
    c. Minimum Effective Modal Bandwidth-Length Product: 4700 MHz-km at 850 nm wavelength.

G. Type OFCP, Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

    a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
    b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

H. Type OFCP, Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Corning or similar
2. Additional Characteristics:

    a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
    b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

2.5 TYPES OFN AND OFNG OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for general use within buildings in accordance with Article 770 of NFPA 70 containing no electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.
b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch.

C. Types OFN and OFNG, Designation OM2, Multimode Optical Fiber Cable

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

D. Types OFN and OFNG, Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

E. Types OFN and OFNG, Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

2.6 TYPES OFC AND OFCG OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for general use within buildings in accordance with Article 770 of NFPA 70 containing noncurrent-carrying electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.
b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch.

C. Types OFC and OFCG, Designation OM2, Multimode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

D. Types OFC and OFCG, Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

E. Types OFC and OFCG, Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable :

1. Corning or similar
2. Additional Characteristics:

a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

2.7 OPTICAL FIBER CABLE HARDWARE

1. Corning or similar

B. Performance Criteria:

1. Fiber Optic Connector Intermateability Standard (FOCIS) specifications of TIA-604 series.
2. TIA-568.3.

C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

D. Patch Cords: Factory-made, dual-fiber cables in 36 inch lengths.

E. Connector Type: Type SC complying with TIA-604-3 connectors.

F. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of single optical fiber cable.
2. Insertion loss not more than 0.75 dB.
3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of single optical fiber cable.
2. Insertion loss not more than 0.75 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to patch panel or faceplate.

2.8 SOURCE QUALITY CONTROL

A. Factory Tests and Inspections:.

1. Test and inspect multimode optical fiber cables, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with TIA-526-14 and TIA-568.3 before delivering to site. Affix label with name and date of qualified electrical testing laboratory's certification of system compliance.
2. Test and inspect pre-terminated optical fiber cable assemblies, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with TIA-526-14 and TIA-568.3 before delivering to site. Affix label with name and date of qualified electrical testing laboratory's certification of system compliance.

B. Nonconforming Work:

1. Cables that do not pass tests and inspections will be considered defective.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate backbone cabling with protectors and demarcation point provided by communications service provider.

3.2 SELECTION OF OPTICAL FIBER TYPE

A. Installed in Vertical Shaft or Floor-to-Floor Riser:

1. Nonconductive:

a. Type OFNR or Type OFNP in listed plenum communications raceway.
b. Type OFNR or Type OFNP in metallic conduit.

B. Installed in Plenum, Duct, or Other Space Handling Environmental Air:

1. Nonconductive:

a. Type OFNP in listed plenum communications raceway.
b. Type OFNR or Type OFNP in metallic conduit.

2. Conductive:

a. Type OFCP in listed plenum communications raceway.
b. Type OFCR or Type OFCP in metallic conduit.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Optical fiber backbone cabling system must provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters may not be used as part of backbone cabling.

C. Comply with BICSI N1, NECA NEIS 1, and NECA NEIS 301.

D. Backbone cabling system must comply with transmission standards in TIA-568.1.

E. Telecommunications Pathways and Spaces: Comply with TIA-569.

F. Wiring Methods:

1. Not in Raceway: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
2. In Raceway: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

a. Install plenum cable in environmental airspaces, including plenum ceilings.

3. In Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

G. Optical Fiber Cabling Installation:

1. Comply with TIA-568.1 and TIA-568.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable may contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inch and not more than 6 inch from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps may not be used for heating.
9. In communications equipment room, provide 10 ft long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

H. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable may not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

I. Installation of Cable Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after flooring system has been installed in raised floor areas.
3. Coil cable 6 ft long not less than 12 inch in diameter below each feed point.

J. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 GROUNDING

A. Install grounding in accordance with BICSI ITSIMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607 and NECA/BICSI-607.

C. Locate grounding bus bar to minimize length of bonding conductors. Fasten to wall allowing at least 2 inch clearance behind grounding bus bar. Connect grounding bus bar with minimum 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to grounding bus bar, using not smaller than 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Cable Schedule: Install in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish electronic copy of final comprehensive schedules for Project.

C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables**,** terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

D. Cable and Wire Identification:

1. Label each cable within 4 inch of each termination and tap, where it is accessible in cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 ft.
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use different color for jacks and plugs of each service.

E. Labels must be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for qualified electrical testing laboratory certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

a. Test instruments must meet or exceed applicable requirements in TIA-568.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction in accordance with TIA-526-14, Method B, One Reference Jumper.
2) Attenuation test results for backbone links must be less than 2.0 dB. Attenuation test results must be less than those calculated in accordance with equation in TIA-568.1.

C. Nonconforming Work:

1. Cables will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective cables and retest.

D. Collect, assemble, and submit test and inspection reports.

1. Data for each measurement must be documented.
2. Data for field quality-control report submittals must be printed in summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from instrument to computer, saved as text files, and printed and submitted.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 271323

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:

1. Backbone communications cable.
2. Communications-, audio/video-, data-, and other signaling-circuit accessories.

B. Field Reports:

1. Factory Test Reports:

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 WARRANTY FOR COMMUNICATIONS COPPER BACKBONE CABLE ASSEMBLIES

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed communications copper backbone cable assemblies perform in accordance with specified requirements and agrees to repair or replace cable assemblies that fail to perform as specified within extended-warranty period.

PART 2 - PRODUCTS

2.1 BACKBONE COMMUNICATIONS CABLES

A. Description: This category covers multiple conductor jacketed communications cable for telephone and other communications circuits for use in risers and plenums as described in Article 800 of NFPA 70.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

2. Listing Criteria:

a. Certified Cable: UL CCN DUZX; including UL 444.
b. Verified Cable: UL CCN DVBI; including TIA-568.2.
c. Type CMP: NFPA 262.
d. Type CMR: UL 1666.
e. Limited Smoke: Marked "-LS" in accordance with UL 1685.
f. Halogen-Free: Marked "-HF" in accordance with UL Subject 2885.
g. Low Smoke and Halogen-Free: Marked "-LSHF" in accordance with IEC 61034-2.
h. Cable Heating Test: Marked "-LP" with current rating and temperature rating.

C. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

3. Factory Tests:

   a. Factory Tests and Inspections: Test and inspect cable on reels, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with TIA-568.2 before delivering to site. Affix label with name and date of manufacturer's UL certification of system compliance.
   b. Nonconforming Work:

      1) Cable reels that do not pass tests and inspections will be considered defective.

   c. Factory Test Reports: Prepare and submit factory test and inspection reports.

D. UL DUZX and DVBI - Type CMP, Category 6 Communications Cable

1. Product Marking: Type CMP; Category 6.
2. Options:

   a. Quantity of Pairs: [4] [Four]
   b. Shielding/Screening: [F/UTP].
   c. Jacket: [Blue] thermoplastic.

E. UL DUZX and DVBI - Type CMP, Category 6A Communications Cable :

1. Product Marking: Type CMP; Category 6A.
2. Options:

   a. Quantity of Pairs: [4][Four]
   b. Shielding/Screening: [F/UTP].
   c. Jacket: [Blue] thermoplastic.

2.2 COMMUNICATIONS-, AUDIO/VIDEO-, DATA-, AND OTHER SIGNALING-CIRCUIT ACCESSORIES

A. Description: This category covers devices intended for use in residential or commercial communications-station applications for connections to communications circuit as defined in Article 800 of NFPA 70.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Communications-Circuit Accessories: UL CCN DUXR; including UL 1863.
b. Audio/Video-, Data-, and Other Signaling-Circuit Accessories: UL CCN DUXR; including UL 1977.
c. For Use in Air-Handling Spaces: UL 2043.

C. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

D. UL DUXR - Connecting Block
1. Leviton
2. Options:

a. Configuration: 110-style IDC for Category 6.
b. Quantity of Terminations: Number of cables terminated on block, plus [25] percent spare, integral with connector bodies, including plugs and jacks where indicated.

E. UL DUXR - Cross-Connect
1. Leviton
2. Options:

a. Number of Terminals per Field: [One] for each conductor in assigned cables.
b. Performance Rating: Category 6/Category 6A]

F. UL DUXR - Patch Panel
1. General Characteristics:

a. Universal T568A and T568B wiring labels.
b. Labeling areas adjacent to conductors.
c. Replaceable connectors.
d. 24 or 48 ports.
e. Construction: 16-gauge steel and mountable on 19 inch equipment racks.

2. Options:

a. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
b. Performance Rating- Category 6 or higher.

G. UL DUXR - Patch Cords

1. General Characteristics:

    a. Factory-made, four-pair cables; terminated with an 8P8C plug at each end.
    b. Bend-relief-compliant boots and color-coded icons to ensure Category 6 performance.
    c. Latch guards to protect against snagging.
    d. Color-coded boots for circuit identification.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:

1. Cable Labeling Schedules: Submit electronic files using software and format requested by Owner.
2. Cabling Administration Diagrams: Submit diagrams and supporting electronic files using software and format requested by Owner.

    a. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

3. Wiring Diagrams:

    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Telecommunications grounding system.
    e. Cross-connects.
    f. Patch panels.
    g. Patch cords.

4. Cross-Connect and Patch Panel Details: Include mounting assemblies, elevations, and physical relationship between installed components.
5. Twisted-Pair Cable Testing Plan: Include list of cables to be tested, identification of tests to be performed, pass/fail criteria, and copy of testing procedures (may be separate volume). Indicate Installer's required tests for warranty compliance.

3.2 SELECTION OF COMMUNICATIONS COPPER BACKBONE CABLING

A. Air-Handling Spaces:

1. Type CMR or Type CMP in metallic conduit installed in accordance with Rule 300.22 of NFPA 70.

B. Vertical Chases:

1. Type CMP or Type CMR in listed plenum or riser communications in metallic conduit installed in accordance with Rule 300.22 of NFPA 70.

3.3 INSTALLATION OF COMMUNICATIONS COPPER BACKBONE CABLING

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation:

1. Communications Cable Assemblies: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with BICSI N1.
2. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

a. Provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure.
b. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters may not be used as part of backbone cabling.

2. Drawings indicate general arrangement of pathways and fittings.

3. Wiring Methods:

a. Raceway and Tray: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

1) Install plenum cable in environmental air spaces, including plenum ceilings.

b. Open-Cable: Route conductors and cables in accessible ceilings, walls, and floors where possible.
c. Within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install cables parallel with or at right angles to sides and back of enclosure.

4. General Requirements for Cabling:

a. Install 110-style IDC termination hardware unless otherwise indicated.
b. Do not untwist twisted-pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
c. Terminate all conductors; no cable may contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
d. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inch and not more than 6 inch from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
e. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.

f. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Use lacing bars and distribution spools.
g. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
h. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps may not be used for heating.
i. In the communications equipment room, install 10 ft long service loop on each end of cable.
j. Pulling Cable: Monitor cable pull tensions.

5. Open-Cable Installation:

a. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
b. Suspend twisted-pair cabling, not in a wireway or pathway, a minimum of 8 inch above ceilings by cable supports not more than 5 ft apart.
c. Cable may not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

6. Installation of Cable Routed Exposed under Raised Floors:

a. Install plenum-rated cable only.
b. Install cabling after the flooring system has been installed in raised floor areas.
c. Coil cable 6 ft long not less than 12 inch in diameter below each feed point.

7. Group connecting hardware for cables into separate logical fields.

8. Separation from EMI Sources:

a. Comply with BICSI N1 for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
b. Separate open communications cables or cables in nonmetallic raceways from unshielded power conductors and electrical equipment as follows:

1) Power Rating Less Than 2 kVA: Minimum 5 inch.
2) Power Rating between 2 and 5 kVA: Minimum 12 inch.
3) Power Rating More Than 5 kVA: Minimum 24 inch.

c. Separate communications cables in grounded metallic raceways from unshielded power lines or electrical equipment as follows:

1) Power Rating Less Than 2 kVA: Minimum 2-1/2 inch.
2) Power Rating between 2 and 5 kVA: Minimum 6 inch.
3) Power Rating More Than 5 kVA: Minimum 12 inch.

d. Separate communications cables in grounded metallic raceways from power lines and electrical equipment located in grounded metallic conduits or enclosures as follows:

1) Power Rating Less Than 2 kVA: No minimum distance.
2) Power Rating between 2 and 5 kVA: Minimum 3 inch.
3) Power Rating More Than 5 kVA: Minimum 6 inch.

e. Separate communications cables from electrical motors and transformers rated 5 kVA or 5 HP and larger minimum 48 inch.
f. Separate communications cables from fluorescent luminaires minimum 5 inch.

9. Identify system components, wiring, and cabling in accordance with TIA-606.

a. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

10. Cable and Wire Identification:

a. Label each cable within 4 inch of each termination and tap, where it is accessible in cabinet or junction or outlet box, and elsewhere as indicated.
b. Each wire connected to building-mounted devices is not required to be numbered at device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
c. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 ft.
d. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

1) Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from panel or cabinet to building-mounted device, with name and number of particular device.
2) Label each unit and field within distribution racks and frames.

e. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use different color for jacks and plugs of each service.

11. Cable Schedule: Install in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish electronic copy of final comprehensive schedules for Project.

12. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

D. Interfaces with Other Work:

1. Entrance Facilities: Coordinate backbone cabling with Section 271100 "Communications Equipment Room Fittings" for cabinets, racks, and protectors and demarcation point provided by communications service provider.
2. Coordinate with Section 078413 "Penetration Firestopping" for sealing fire-rated penetrations.
3. Coordinate with Section 260533.16 "Boxes and Covers for Electrical Systems" for installation of outlet boxes and cover plates.

3.4 FIELD QUALITY CONTROL OF COMMUNICATIONS COPPER BACKBONE CABLING

A. Acceptance Testing Preparation:

Field tests and inspections must be witnessed by authorities having jurisdiction

B. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Visually inspect jacket materials for certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568.1.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments must meet or exceed applicable requirements in TIA-568.2. Perform tests with a tester that complies with performance requirements in "Test Instruments" Annex, complying with measurement accuracy specified in "Measurement Accuracy" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

C. Nonconforming Work:

1. Cable assemblies will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective cable assemblies and retest.

D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.5 PROTECTION

A. After installation, protect cable assemblies and accessories from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 27 13 13

SECTION 27 15 13 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Category 6a twisted pair cable.
3. Twisted pair cable hardware.
4. Cable management system.

1.2 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.4 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated:

a. Type CMP complying with UL 1685
b. Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2. Communications, Non-Plenum Rated:

a. Type CMP or Type CMR in listed plenum or riser communications raceway.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.

B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Shielded twisted pairs (FTP)

2.4 CATEGORY 6a TWISTED PAIR CABLE

A. Description: Four-pair, balanced twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500 MHz.

B. Standard: Comply with TIA-568-C.2 for Category 6a cables.

C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Shielded twisted pairs (FTP).

2.5 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6/ Category 6a.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.

D. Connecting Blocks:

1. 110-style IDC for Category 5e.
2. 110-style IDC for Category 6.
3. 110-style IDC for Category 6a.
4. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

5. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:

a. Universal T568A and T568B wiring labels.
b. Labeling areas adjacent to conductors.
c. Replaceable connectors.
d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.

F. Patch Cords: Factory-made, four-pair cables in 48-inch lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

G. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
3. Marked to indicate transmission performance.

H. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or cover plate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

I. Cover Plate:

1. Two and Four port, vertical single gang cover plates designed to mount to single gang wall boxes.
2. Plastic Cover Plate: High-impact plastic. Coordinate color with Section 260533.16 " Boxes and Covers for Electrical Systems."
3. Metal Cover Plate: complying with requirements in Section 260533.16 " Boxes and Covers for Electrical Systems."
4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

J. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.6 CABLE MANAGEMENT SYSTEM

A. Document physical characteristics by recording the network, TIA details, and connections between equipment and cable.

B. Information shall be presented in database view or technical drawings.

1. AutoCAD or Revit drawing software shall be used as drawing and schematic plans software.

C. System shall interface with the following testing and recording devices:

1. Direct upload tests from circuit testing instrument into the personal computer.
2. Direct download circuit labeling into labeling printer.

PART 3 - EXECUTION

3.1 INSTALLATION OF TWISTED PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. Routing: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

D. General Requirements for Cabling:

1. Comply with TIA-568-C.1.
2. Comply with BICSI's Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

3.2 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.3 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

C. Comply with TIA-607-B and NECA/BICSI-607.

D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

E. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Equipment grounding conductors.

C. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.

b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

D. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.5 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for 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.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

D. Nonconforming Work:

1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. Collect, assemble, and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.6 MAINTENANCE

1. Upgrade Reports: Prepare report after each update, documenting upgrades installed.

END OF SECTION 27 15 13

SECTION 27 15 23 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 62.5/125-micrometer, multimode, optical fiber cable (OM1).
2. 50/125 micrometer, multimode, indoor-outdoor optical fiber cable (OM2).
3. 9/125 micrometer, single-mode, optical fiber cable (OS1).
4. 9/125 micrometer, single-mode, indoor-outdoor optical fiber cable (OS2).
5. Optical fiber cable hardware.
6. Cross-connects and patch panels.
7. Grounding.
8. Identification products.

1.2 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

A. Optical fiber horizontal cabling system is to provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1," or Distributor C and the equipment outlet, otherwise known as "Centralized Cabling," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling is to contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.
3. Bridged taps and splices are not to be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.3 ACTION SUBMITTALS

A. Product Data:

1. 62.5/125-micrometer, multimode, optical fiber cable (OM1).
2. 50/125 micrometer, multimode, optical fiber cable (OM2).
3. 9/125 micrometer, single-mode, indoor-outdoor optical fiber cable (OS1).
4. 9/125 micrometer, single-mode, indoor-outdoor optical fiber cable (OS2).
5. Optical fiber cable hardware.
6. Cross-connects and patch panels.

7. Grounding.
8. Identification products.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules:

a. Electronic copy of labeling schedules, in software and format selected by Owner.

2. Cabling administration Drawings and printouts.
3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment.

C. Fiber optic cable testing plan.

D. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

E. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings Cabling Administration Drawings, and field testing program development] by an [RCDD] or Fiber Optic [Technician].
2. Installation Supervision: Installation is to be under the direct supervision of Level 2 Installer, who is to be present at all times when Work of this Section is performed at Project site.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system is to comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 62.5/125-MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM1)

A. Description: Multimode, 62.5/125-micrometer, [4] fiber, nonconductive, tight buffer, optical fiber cable.

B. Corning or similar

C. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAA for detailed specifications.

D. Conductive cable is to be [aluminum] armored type.

E. Maximum Attenuation: [3.50] dB/km at 850 nm; [1.5] dB/km at 1300 nm.

F. Minimum Overfilled Modal Bandwidth-length Product: 200 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

G. Jacket:

1. Jacket Color: Orange .
2. Cable cordage jacket, fiber, unit, and group color are to be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

H. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive:

a. Type OFNP in listed plenum communications raceway.

2. Plenum Rated, Conductive:
a. Type OFCP or Type OFNP in listed plenum communications raceway.

2.3 50/125 MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM2)

A. Description: Multimode, 50/125-micrometer, [4] fiber, nonconductive, tight buffer, optical fiber cable.

B. Corning or similar

C. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAB for detailed specifications.

D. Conductive cable is to be armored type.

E. Maximum Attenuation: 3.50 dB/km at 850 nm.

F. Minimum Overfilled Modal Bandwidth-length Product: 500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

G. Jacket:

1. Jacket Color: Orange .
2. Cable cordage jacket, fiber, unit, and group color are to be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

H. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive:
   a. Type OFNP in listed plenum communications raceway.

2. Plenum Rated, Conductive:
   a. Type OFCP or Type OFNP in listed plenum communications raceway.

2.4 9/125 MICROMETER SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS1)

A. Description: Single mode, 9/125-micrometer, [**2**] fibers, tight buffered, nonconductive optical fiber cable

B. Corning or similar

C. Conductive cable is to be armored type.

D. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 > dB/km at 1550 nm.

E. Jacket:

1. Jacket Color: Yellow
2. Cable cordage jacket, fiber, unit, and group color are to be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

F. Standards:

1. Comply with TIA-492CAAA for detailed specifications.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with ICEA S-104-696 for mechanical properties.

G. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive:
   a. Type OFNP in listed plenum communications raceway.

2. Plenum Rated, Conductive:
   a. Type OFCP or Type OFNP in listed plenum communications raceway.

2.5 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

A. Description: Single mode, 9/125-micrometer, [**2**] fibers, tight buffered, nonconductive optical fiber cable.

B. Corning or similar

C. Conductive cable is to be armored type.

D. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

E. Jacket:

1. Jacket Color: Yellow .
2. Cable cordage jacket, fiber, unit, and group color are to be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

F. Standards:

1. Comply with TIA-492CAAB for detailed specifications.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with ICEA S-104-696 for mechanical properties.

G. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive:
   a. Type OFNP in listed plenum communications raceway.

2. Plenum Rated, Conductive:

   a. Type OFCP or Type OFNP in listed plenum communications raceway.

2.6 OPTICAL FIBER CABLE HARDWARE

A. Corning or similar

B. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: [**One**] for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

D. Patch Cords: Factory-made, single-fiber cables in 36-inch lengths.

E. Connector Type: Type SC complying with TIA-604-3-B connectors.

F. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than **0**.75 dB.
3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.75 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a patch panel or faceplate.

H. Faceplate:

1. [Two] and [Four] -port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
    a. Flush mounting jacks, positioning the cord at a 45-degree angle.

2.7 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.8 SOURCE QUALITY CONTROL

A. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

B. Factory test preterminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable is to contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. 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.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps are not to be used for heating.
9. In the communications equipment room, provide a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Wiring Method, Raceways: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Wiring Method, Concealed: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

F. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable is not to be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

G. 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. Coil cable 6 feet long not less than 12 inches diameter below each feed point.

H. Group connecting hardware for cables into separate logical fields.

3.2 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.3 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

D. Labels are to be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative].

B. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for 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. Optical Fiber Cable Tests:

a. Test instruments are to meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

1) Horizontal and Multimode Horizontal Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
2) Attenuation test results for horizontal links are to be less than 2.0 dB. Attenuation test results are to be less than those calculated according to equation in TIA-568-C.1.

C. Data for each measurement are to be documented. Data for submittals are to be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 271523

SECTION 27 52 23 - NURSE CALL/CODE BLUE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes visual/tone nurse-call system.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Equipment cabinets.
2. Cabling diagrams.
3. Station installation details.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Compatibility: System shall be capable of integration with any brand of phone system (wired or wireless), staff locating system, CCTV, and fire-alarm system.

C. Electrical Components, Devices, and Accessories: Listed and labeled according to UL 1069 as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 NURSE-CALL SYSTEM GENERAL REQUIREMENTS

A. Station Zones: Able to program [256] station zones for each master station in the network with [eight] priority levels and addressable visual and audible annunciation of audible devices such as smoke detectors and door contacts.

B. System shall provide integrated and centralized "Code Blue" and "Staff Emergency" calls.

C. Expansion Capability: Equipment ratings, housing volume, spare keys, switches, relays, annunciator modules, terminals, and cable conductor quantities adequate to increase the number of stations in the future by [25] percent above those indicated without adding internal or external components or main trunk cable conductors.

D. Resistance to Electrostatic Discharge: System, components, and cabling, and the selection, arrangement, and connection of materials and circuits, shall be protected against damage or diminished performance when subjected to electrostatic discharges of up to 25,000 V in an environment with a relative humidity of 20 percent or less.

E. Equipment: Microprocessor, electronic, modular.

F. Master Nurse-Call Station: Programmed via a PC.

G. Wall-Mounted Component Connection Method: Components connect to system wiring in back boxes with factory-wired plug connectors.

H. Telephone Interface: Permit use of wired and wireless telephones to execute nurse-call master station functions.

I. Third-Party Pager Interface: Programmable to send tone, numeric, and alphanumeric message to pocket pagers or personal digital assistants and to use industry standard-protocol, RS-485 interface.

2.2 VISUAL/TONE NURSE-CALL SYSTEM

A. Operational Requirements:

1. Patient Station Call: Lights a steady call-placed lamp on the station, steady lamps in the zone light and corridor dome light associated with the patient's room, and steady lamps at the central annunciator and other system display devices and displays message on master and staff/duty stations. At the same time, it sounds a programmed tone at intervals, at the respective annunciator and master and staff/duty stations. Legends at the central annunciator and master station identify the calling station.
2. Pull-Cord-Call Station Call: Flashes a call-placed lamp on the station and distinctive-color lamps in the zone light and corridor dome light and at the central annunciator and staff/duty stations. At the same time, it sounds a programmed tone at intervals, at the central annunciator and master and staff/duty stations. A legend at the master station identifies the calling station, priority as programmed, and bed identification.
3. Emergency-Call Station Call: Produces the same responses as pull-cord-call station calls except rapidly flashing red emergency digital display and tone repetition rates are more

frequent, tone frequency is higher, and lamps in the zone light and corridor dome light are a different color. Indicator lamps may be extinguished and the system reset only at the calling station. Displays message on pocket pagers, sounds programmed tone on phones, and displays message on display equipped phones.

4. System Reset: Operating reset button at the originating station cancels signals associated with the call. Illuminates a green digital display on the patient station and log presence on the master station.
5. Cord-Set Removal: Initiates a patient station call when the cord set is removed from the jack in the patient station faceplate. Displays location and "cord removed" message on master station, pocket pagers, and display equipped phones. Inserting a cord-set plug or a dummy plug into the jack and operating the station reset button resets the call.
6. Patient Control Unit: Controls entertainment volume and channel selection. Nurse button on the unit initiates a patient station call. Integral speaker reproduces entertainment sound.
7. Emergency Bath Station Call: Illuminates the digital display on the emergency bath station; rapidly flashes white dome lamp; displays location, priority, and bath on master station; and sounds programmed tone on master station display equipped phones and pocket pagers.
8. Staff/Duty Station Operation: Operation shall be identified to patient station except the message staff shall display on all devices when the staff call button is activated.
9. Privacy Key Activation: When privacy key is activated on patient station, the system shall disconnect the patient station microphone and slowly flash yellow privacy digital display on the patient station. Displays "privacy" on master station when selecting this room/bed.

B. Central Annunciator:

1. Lamp type.
2. Lamp Legends: Machine lettered and legible from a distance of at least 48 inches when a call is present. Legend shall identify initiating station and priority of call.
3. Power-on Indicator: Digital, or push-to-test switch.
4. Audible Signal: Electronic tone.

C. Central Equipment Cabinet:

1. Lockable metal.
2. Houses power supplies, controls, terminal strips, and other components.
3. Power-on indicator lamp.

D. Single-Patient Station: Call-placed lamp, reset push button, and polarized receptacle matching cord-set plug; mounted in a single faceplate.

E. Dual-Patient Station: Single call-placed lamp, single reset push button, and two polarized receptacles matching cord-set plug; mounted in a single faceplate.

F. Ambulatory-Patient Station: Call push-button switch, call-placed lamp, and reset push button; mounted in a single faceplate.

G. Staff/Duty Stations: A minimum of two call lamps, one for routine calls and one for emergency calls; and an audible tone signal device.

2.3 SYSTEM COMPONENTS

A. Emergency-Call Station: Locking-type push button, labeled "Push to Call Help"; reset trigger to release push button and cancel call; and call-placed lamp, mounted in a single faceplate.

B. Emergency-Bath Station:

1. Consists of a sliding, chemical-resistant, ABS red fascia marked with the word "URGENT" in bold letters.
2. Capable of being activated with nylon pull cord or by sliding the face of the unit downwards.
3. Activation of the station shall illuminate a reassurance digital display on the face of the unit in addition to notifying the master station.
4. Water resistant and able to withstand routine cleaning and chemical disinfectants.
5. Uses magnetic reed switch technology for reliability and corrosion resistance.
6. Mounts on a single-gang electrical box wire to the respective patient station or input controller.

C. Code Blue Station:

1. Consists of a sliding, chemical-resistant, ABS blue fascia marked with the word "CODE" in bold letters.
2. Capable of being activated with nylon pull cord or by sliding the face of the unit downwards.
3. Activation of the station shall illuminate a reassurance digital display on the face of the unit in addition to notifying the master station.
4. Water resistant and able to withstand routine cleaning and chemical disinfectants.
5. Uses magnetic reed switch technology for reliability and corrosion resistance.
6. Mounts on a single-gang electrical box wire to the respective patient station or input controller.

D. Staff, Emergency Station:

1. Consists of a sliding, chemical-resistant, ABS red fascia marked with the word "EMERGENCY" in bold letters.
2. Capable of being activated with nylon pull cord or by sliding the face of the unit downwards.
3. Activation of the station shall illuminate a reassurance digital display on the face of the unit in addition to notifying the master station.
4. Mounts on a single-gang electrical box wire to the input controller.

E. Pull-Cord-Call Station:

1. Pull-Down Switch: Lever-locking type, labeled "Pull Down to Call Help."
2. Reset trigger.
3. Call-placed lamp.
4. Water-resistant construction.

F. Patient Control Unit:

1. Equipped with plug and 96-inch- long white cord.
2. Ethylene oxide, sterilizable.

G. Call-Button Cord Set:

1. Plug and 72-inch white cord; cord set shall be resistant to medical gas environment equipped with momentary-action, call-button switch.
2. Ethylene oxide, sterilizable.
3. Washable cord.
4. Palladium switch contacts in high-impact white housing with cord-set strain relief.
5. Attachment: Stainless steel bed clamp with permanently attached polyester film strap.
6. Quantity: Three cord sets for every 10 patient beds.

H. Geriatric Call-Button Cord Set:

1. Plug and 72-inch white cord.
2. Resistant to medical gas environment equipped with momentary-action, light-pressure switch in soft outer jacket.
3. Ethylene oxide, sterilizable.
4. Washable cord.
5. Palladium switch contacts in high-impact white housing with cord-set strain relief.
6. Attachment: Stainless steel bed clamp with permanently attached polyester film strap.
7. Quantity: Two cord sets for every 10 patient beds.

I. Squeeze-Bulb Switch Cord Set:

1. Plug and 72-inch washable tube with white cord set.
2. Resistant to medical gas environment; washable; equipped with neoprene squeeze-bulb activator, and plug-mounted, momentary contact switch.
3. Ethylene oxide, sterilizable.
4. Attachment: Stainless steel bed clamp with permanently attached polyester film strap.
5. Quantity: Two cord sets for every 10 patient beds.

J. Breath Call Cord:

1. Flexible PVC jacketed cable and a momentary contact air-pressure sensitive switch.
2. Cord: 108 inches long.
3. Include an adjustable arm for clamping and suitable for use in oxygen atmospheres.
4. Include 12 replacement straws.

K. Pillow Speakers:

1. Eight-conductor, DIN, flexible PVC jacketed cable.
2. Contain nurse-call button, volume control, speaker, and channel control in molded flame-retardant ABS housing.
3. Cord: 96 inches long with sheet clip.

L. Call-Button Plug:

1. Designed to plug into patient station cord-set receptacle.
2. Button switches call circuit.
3. Two plugs for every 10 patient beds.

M. Dummy Plugs:

1. Designed to plug into patient station cord-set receptacle when call-button plug or patient cord set is not used.
2. Three plugs for every 10 patient beds.

N. Indicator Lamps: Digital type with rated life of 20 years unless otherwise indicated.

1. Station Faceplates, Stainless Steel:

a. Stainless steel, a minimum of 0.0375 inch thick.
b. Finish: Brushed.
c. Machine-engraved labeling identifies indicator lamps and controls.

2. Station Faceplates, High-Impact Plastic:

a. High-impact plastic.
b. Color: Determined by Owner/Architect.
c. Molded or machine-engraved labeling identifies indicator lamps and controls.

O. Corridor Dome Lights and Zone Lights:

1. Three-lamp signal lights.
2. Lamps: Front replaceable without tools, low voltage with rated life of 7500 hours. Barriers are such that only one color is displayed at a time.
3. Lenses: Heat-resistant, shatterproof, translucent polymer that will not deform, discolor, or craze when exposed to hospital cleaning agents.
4. Filters: Two per unit, amber and red.

P. Cable:

1. Conductors: Jacketed single and multiple, twisted-pair copper cables.
2. Sizes and Types: As recommended by equipment manufacturer.
3. Cable for Use in Plenums: Listed and labeled for plenum installation.

Q. Grounding Components: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

2.4 SOFTWARE REQUIREMENTS

A. Telephone System Interface:

1. Permits use of wired and/or wireless telephones to execute nurse-call master station.
2. Two-way communication with patient and staff stations.
3. Two-way communication with the master nurse station.
4. "All Call," group call, and staff call paging.
5. Capable of being programmed to forward calls destined for a master nurse station to any connected telephone.
6. Telephones connected to the telephone interface shall have the same call tone ring patterns as those generated at the master nurse station.
7. Telephones having a display shall indicate the call type, priority code, and the calling station number of incoming calls.

8. Telephones shall be capable of initiating a service request for a particular patient station, logging calls on the master station's reminder list, and activating door lock mechanisms associated with a call station.
9. Capable of routine setup and configuration changes using the keypads on display telephone and/or the master station.

B. Display Telephones:

1. Digital telephones for use as mini-master nurse-call stations.
2. Digital display shall indicate the call type, priority code, and calling station number of incoming calls.
3. Ring patterns shall be identical to those generated at the master station.
4. Capable of two-way communication with patient and staff stations and the master station, and other telephones interfaced with the system.
5. Capable of placing or answering outside calls when interfaced with the facility telephone system.
6. Capable of "All Call," group call, and staff call paging and of initiating service requests, logging calls to the reminder list, and activating optional door controls.

C. Third-Party Pocket Pager Interface:

1. Equipped with a standalone pocket pager interface.
2. Connects with the facility paging system and transmit alphanumeric messages to the pocket pagers as preprogrammed in the system.

D. Statistical Software:

1. Includes a data statistical software package that stores, sorts, and analyzes activities occurring on the nurse-call system network.
2. Windows based and operated on a PC that is connected to the nurse-call system network.
3. Stores events on the PC's hard disk. Accumulation of these stored events shall make up the database that is used to generate reports and statistics.
4. Events stored by the software shall include date, day of week, time, ward, priority, and room number.
5. Capable of assigning a patient name to bed number.
6. Stored events shall include, but not be limited to, calls placed, call priority, calls cancelled at the nurse station, calls cancelled at the point of origin, regenerated calls, calls answered, calls sent to pager interface, staff presence registration, staff presence cancellation, service request, service cancellation, and system and network error messages.

E. Data Analysis Software:

1. Capable of analyzing the stored information and generating computed analysis.
2. Analysis of the database can be conducted by specifying one, many, or all of the following parameters of the database: date, day of week, time, wards, priority, and room number.
3. Analysis shall include, but not be limited to, total number of calls placed, average call response time (from call placed to call cancellation), total number of presence registrations, average presence time in a room, total number of service requests, average response time (from audio answer to call cancellation), and average ring time (from call placed to audio answer).

F. Statistical Software Package:

1. Capable of displaying multiple calls/events on a PC monitor or on a RS-485 data-bus-driven digital display panel.
2. Calls from patient or staff stations and associated devices shall be displayed by priority. Display shall be customizable as follows:

a. Choice of color by type of call.
b. Choice of display size (character size).
c. Choice of priority levels, type of events, points of origin.
d. Identification of facility.
e. Identification of ward.
f. Identification of patient with specific patient information.

2.5 CONDUCTORS AND CABLES

A. Audio Cables:

1. Conductors: Jacketed, twisted-pair and twisted-multipair, untinned solid copper. Sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.
2. Insulation: Thermoplastic, not less than 1/32 inch thick.
3. Minimum Shielding Coverage on Conductors: 60 percent.
4. Plenum Cable: Listed and labeled for plenum installation.

B. Data Cable and Hardware: Category 6 or higher balanced twisted-pair cabling and hardware. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

C. Power Conductors and Cables: Copper, solid, No. 20 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Grounding Conductors and Cables: Copper, stranded, No. 16 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wiring Method:

1. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters[and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used].

a. Install plenum cable in environmental air spaces, including plenum ceilings.
b. Conceal raceway and cables except in unfinished spaces.

c. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

B. Install cables without damaging conductors, shield, or jacket.

C. Do not bend cables, while handling or installing, to radii smaller than as recommended by manufacturer.

D. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than one is being installed in same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.

E. Install exposed raceways and cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by straps, staples, or similar fittings designed and installed so as not to damage cables. Secure cable at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, or fittings.

F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

G. Separation of Wires: Separate speaker/microphone, line-level, speaker-level, and power-wiring runs. Run in separate raceways or, if exposed or in same enclosure, provide 12-inch minimum separation between conductors to speaker/microphones and adjacent parallel power and telephone wiring. Provide separation as recommended by equipment manufacturer for other conductors.

H. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Install terminal cabinets where there are splices, taps, or terminations for eight or more conductors.

I. Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks if required.

J. Identification of Conductors and Cables: Comply with requirements in Section 260553 "Identification for Electrical Systems" for cable administration, cable schedule, and cable and wire identification.

K. Equipment Identification:

1. Comply with requirements in Section 260553 "Identification for Electrical Systems" for equipment labels and signs and labeling installation requirements.
2. Label stations, controls, and indications using approved consistent nomenclature.

3.2 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other signal impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding except at connection to main building ground bus.

C. Grounding Provisions: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 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.

B. Perform tests and inspections.

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.

C. Tests and Inspections:

1. Schedule tests a minimum of seven days in advance.
2. Report: Submit a written record of test results.
3. Operational Test: Perform an operational system test and demonstrate proper operations, adjustment, and sensitivity of each station. Perform tests that include originating station-to-station and "All Call" messages and pages at each nurse-call station. Verify proper routing, volume levels, and freedom from noise and distortion. Test each available message path from each station on the system. Meet the following criteria:

    a. Speaker Output: 90 dB plus or minus 3 dB, 300 to 3000 Hz, reference level threshold of audibility 0 dB at 0.02 mPa of sound pressure.
    b. Gain from patient's bedside station to nurse station, with distortion less than 65 dB (plus or minus 3 dB, 300 to 3000 Hz).
    c. Signal-to-Noise Ratio: Hum and noise level at least 45 dB below full output.

4. Test Procedure:

    a. Frequency Response: Determine frequency response of two transmission paths by transmitting and recording audio tones.
    b. Signal-to-Noise Ratio: Measure the ratio of signal to noise of the complete system at normal gain settings using the following procedure: Disconnect a speaker/microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure the ratio of signal to noise and repeat the test for four speaker microphones.
    c. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 300, 400, 1000, and 3000 Hz into each nurse-call equipment amplifier, and measure the distortion in the amplifier output.

D. Retesting: Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify, by the system test, that the total system meets these Specifications and complies with applicable standards. Report results in writing.

E. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

F. Prepare test and inspection reports.

END OF SECTION 27 52 23

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SECTION 28 00 10 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 28.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for abbreviations and acronyms for electrical terms and units of measure, abbreviations and acronyms for electrical raceway types, abbreviations and acronyms for electrical cable types, and additional coordination drawing submittal requirements.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electronic Safety and Security:

1. ACU: (mass notification) Autonomous control unit.
2. BMS: Building management system.
3. FACU: Fire-alarm control unit.
4. HPSA: (mass notification) High power speaker array.
5. LOC: (mass notification) Local operator console.
6. PoE: Power over Ethernet.
7. POTS: Plain old telephone service. See "public switched telephone network."
8. SCBA: Self-contained breathing apparatus.
9. TCP/IP: Transmission control protocol/Internet protocol.

B. Definitions for Electronic Safety and Security:

1. Calling Party Control (CPC): A momentary break in phone line loop current, which is used to signal voicemail and other automated telephone company services that distant party has hung up.
2. Private Branch Exchange (PBX): Analog telephone switch that routes calls internal to a business or organization so a direct external line for each phone is unnecessary.
3. Public Switched Telephone Network (PSTN): Analog telephone technology that uses twisted-pair cables from a telephone-provider central office for the transmission medium. PSTN refers to the telephone network; POTS refers to the individual subscriber line.
4. Remote Office Phone System (ROPS): VoIP system that allows phones for a business or organization located anywhere in the world with internet connectivity to behave similar to phones connected to a PBX.
5. Ringer Equivalence Number (REN): The loading effect of a single traditional telephone ringing circuit. TIA-968 defines REN 1 as an impedance of 7000 Ω at 20 Hz (Type A

ringer) or 8000 Ω from 15 Hz to 68 Hz (Type B ringer). The sum of the RENs for all devices on a subscriber line circuit may not exceed the maximum permitted REN for the subscriber line.

6. Voice over Internet Protocol (VoIP): Digital telephone packet technology that uses the internet for its transmission medium.

1.3 COORDINATION

1.4 INFORMATIONAL SUBMITTALS

A. Installation Schedule for Security, Fire Alarm, and Other Life Safety Systems: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for installation of security, fire alarm, and other life safety Work to Owner and Architect including, but not limited to, milestone dates for the following activities:

1. Submission of specified coordination drawings.
2. Submission of action submittals specified in Division 28.
3. Orders placed for major equipment.
4. Arrival of major equipment on-site.
5. Preinstallation meetings specified in Division 28.
6. Security and fire-alarm system outages.
7. Security and fire-alarm system inspection and activation.
8. Mockup reviews.
9. Closing of walls and ceilings containing security and fire-alarm Work.
10. System startup, testing, and commissioning activities for security and fire-alarm equipment.
11. System startup, testing, and commissioning activities for fire-alarm interfaces with Work specified in other divisions.
12. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
13. Requests for special inspections.
14. Requests for inspections by authorities having jurisdiction.

15. Wind-Load Performance Certificates: Provide special certification for designated wind-load systems and components identified on Drawings or in the Specifications.

    a. Include the following information:

        1) Provide equipment manufacturer's written certification for each designated system and component, stating that it will remain in place and operable following the design wind event and comply with requirements of authorities having jurisdiction.
        2) Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

    b. The following systems and components are designated wind-load systems requiring written special certification of resistance to effects of high wind-load and impact damage by manufacturer:
        1) Exterior access control components and equipment specified in Section 281511 "Integrated Credential Readers and Entry Management."

2) Exterior access control components and equipment specified in Section 281515 "Electrified Locking Devices and Accessories."
3) Exterior access control components and equipment specified in Section 281517 "Egress Management Devices."
4) Housings, illuminators, and pan-tilt-units for video surveillance equipment specified in Section 282000 "Video Surveillance."

B. Qualification Statements:

1. For qualified regional manufacturer.
2. For structural professional engineer.
3. For security design professional.
4. For life safety professional engineer.
5. For welder.
6. For fire-alarm cable Installer.
7. For security testing agency and on-site security testing supervisor.
8. For fire-alarm testing agency and on-site fire-alarm testing supervisor.
9. For structural testing and inspecting agency.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRONIC SAFETY AND SECURITY EQUIPMENT

A. Substitution requests for electronic safety and security equipment will be entertained under the following conditions:

1. Substitution requests may be submitted for consideration prior to the Electronic Safety and Security Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
2. Contractor is responsible for sequencing and scheduling equipment procurement. After the Electronic Safety and Security Preconstruction Conference, insufficient lead time for equipment delivery will not be considered a valid reason for substitution.

2.2 INSTALLATION OF ELECTRONIC SAFETY AND SECURITY WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' instructions, comply with NFPA 70, NFPA 72, NFPA 731, and NECA NEIS 1 for installation of Work specified in Division 28. Consult Architect for resolution of conflicting requirements.

2.3 FIELD QUALITY CONTROL

A. Administrant for Security Tests and Inspections:

1. Owner will engage qualified security testing and inspecting agency to administer and perform tests and inspections.

B. Administrant for Fire-Alarm Tests and Inspections:

1. [**Owner**] will engage qualified fire-alarm testing and inspecting agency to administer and perform tests and inspections.

2.4 CLOSEOUT ACTIVITIES

A. Training:

1. With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:

a. How to adjust, operate, and maintain access control workstations, software, and databases specified in Section 281300 "Access Control Software and Database Management."
b. How to enroll users and issue user credentials specified in Section 281519 "Access Control Remote Devices."
c. How to adjust, operate, and maintain video surveillance equipment specified in Section 282000 "Video Surveillance."

END OF SECTION 28 00 10

SECTION 28 10 00 - ACCESS CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access control system.

B. Products Installed, but Not Furnished, under This Section:

1. Door Hardware

a. Electric strike(s).
b. Electromagnetic lock(s).
c. Delayed-egress electromagnetic lock(s).
d. Electromechanical lock(s).
e. Self-contained electronic lock(s).
f. Exit lock(s) and alarm(s).
g. Auxiliary electrified door hardware.

2. Power Door Operators:

a. Door operator controls.
b. Panic exit device(s).
c. Electric strike(s).
d. Auxiliary electrified door hardware.

3. Access Control Software and Database Management:

a. Access control system unit operating system software.
b. Access control system unit antivirus and security protection software.
c. Visitor management database software.
d. Mobile credential validation database software.

4. Access Control System Hardware:

a. Access control system server(s).
b. Access control system DGP(s).
c. Access control system door controller(s).
d. Access control system input/output interface(s).
e. Access control system power supply and battery charger(s).

5. Integrated Access Control Hardware Devices:

a. Swipe card reader(s).
b. Proximity reader(s) for card, fob, or smartphone.
c. Door lock keypad(s).
d. Scramble keypad(s).
e. Combination card reader(s) and keypad(s).

f. Access control cards.
g. Electrically controlled single-point latch(es).
h. Electrically controlled three-point latch(es).
i. Type 1 high-security electronic lock(s).
j. Type 1F high-security combination lock(s).
k. REX motion sensor(s).
l. REX push-button(s).
m. Magnetic lock hardware with special locking arrangement for fire-rated door(s).
n. Panic hardware with special locking arrangement for fire-rated door(s).
o. NFC access control device(s).
p. Electronic key management system unit(s).

6. Integrated Credential Readers and Entry Management:

a. Swipe card reader(s).
b. Chip card reader(s).
c. Proximity reader(s) for card, fob, or smartphone.
d. Proximity card reader(s) for hazardous (classified) location.
e. Door lock keypad(s).
f. Scramble keypad(s).
g. Combination card reader(s) and keypad(s).

7. See Section 281515 "Electrified Locking Devices and Accessories" for the following:

a. Electrically controlled single-point latch(es).
b. Electrically controlled three-point latch(es).
c. Type 1 high-security electronic lock(s).
d. Type 1F high-security combination lock(s).
e. REX motion sensor(s).
f. REX push-button(s).

8. See Section 281517 "Egress Management Devices" for the following:

a. Magnetic lock hardware with special locking arrangement.
b. Panic hardware with special locking arrangement.

C. Related Requirements:

D.

1. Section 280010 "Supplemental Requirements for Electronic Safety and Security" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. REX: Request-to-exit.

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Project general notes.

2. Head-end hardware, equipment, and device locations.
3. Block diagram and cable/conduit routing illustrating end-to-end system wiring.
4. End-to-end system communications details.
5. Secondary power calculations

B. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installation and programming instructions for operating system software, including all applicable software add-ons.
2. Installation and programming instructions for antivirus and security protection software.
3. Manufacturer's recommended setup and testing procedure for operating system software and applicable software add-ons.
4. Troubleshooting instructions for operating system software and applicable software add-ons.
5. Manufacturer's recommended setup and testing procedure for antivirus and security protection software.
6. Troubleshooting instructions for antivirus and security protection software.
7. Installation instructions for access control system servers.
8. Installation instructions for access control system DGPs.
9. Installation instructions for access control system input/output interface.
10. Installation instructions for access control system door controllers.
11. Installation instructions for access control system power supplies and battery chargers.
12. Manufacturer's recommended testing and inspection procedure for operation of access control system servers, panels, input/output interfaces, and door controllers.
13. Manufacturer's recommended testing and inspection procedure for operation of access control system power supplies and battery chargers.
14. Installation instructions for integrated credential readers and entry management devices.
15. Handling instructions for access control credentials.
16. Installation instructions for electrified locking devices and accessories.
17. Installation instructions for egress management devices.
18. Installation instructions for access control remote devices.
19. Installation instructions for telephone entry systems.
20. Installation instructions for intercom entry systems.
21. Installation instructions for electronic key management systems.
22. Installation instructions for access control electronic turnstiles and mobility systems.
23. Manufacturer's recommended tests and inspections for integrated credential readers and entry management devices.
24. Manufacturer's recommended tests and inspections for electrified locking devices and accessories.
25. Manufacturer's recommended tests and inspections for egress management devices.
26. Manufacturer's recommended tests and inspections for access control remote devices.
27. Manufacturer's recommended tests and inspections for telephone entry systems.
28. Manufacturer's recommended tests and inspections for intercom entry systems.
29. Manufacturer's recommended tests and inspections for electronic key management systems.
30. Manufacturer's recommended tests and inspections for access control electronic turnstiles and mobility systems.

31. Manufacturer's recommended testing and inspection procedure for end-to-end operation of access control system software, hardware, and integrated hardware devices.

1.5 REGULATORY AGENCY APPROVALS

A. Submittals for access control system require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESS CONTROL SYSTEM

A. Description: Access control system provides a means of regulating or controlling physical entry into an area, or access to or use of a device by electrical, electronic, and/or mechanical means. Typical access control system includes a card reader at a controlled door, which reads a user credential and sends the collected data to a centrally located DGP over the cabling infrastructure. DGP may hold a user database onboard or may communicate with a user database over the network. If user is authorized for access at a controlled door, DGP signals the electronic lock at the door to unlock. If user credential is not authorized according to user database, the door remains locked and access is denied. In addition to card readers and electronic locks, access control systems may include various other connected devices programmed for a desired function.

B. Performance Criteria:

1. Regulatory Requirements:

a. Components listed and labeled in accordance with NFPA 70 and NFPA 72, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
b. Comply with NFPA 1, NFPA 730, NFPA 731, and ICC IBC.

C. Selection of Access Control System Components:

1. Source Limitations: Obtain components for access control system from sources approved by [Manufacturer] or [Installer] warranting performance of entire system.
2. Provide the following specified products with the access control system:

a. Access Control Software and Database Management:

1) Access control system unit operating system software.
2) Access control system unit antivirus and security protection software.
3) Visitor management database software.
4) Mobile credential validation database software.

b. Access Control System Hardware:

1) Quantity as indicated on Drawings of access control system server(s)

2) Quantity as indicated on Drawings of access control system DGP(s) <
3) Quantity as indicated on Drawings of access control system door controller(s)
4) Quantity as indicated on Drawings of access control system input/output interface(s)
5) Quantity as indicated on Drawings of access control system power supply and battery charger(s)

c. Security Door Hardware:

1) Quantity as indicated on Drawings of electric strike(s) .
2) Quantity as indicated on Drawings of electromagnetic lock(s).
3) Quantity as indicated on Drawings of delayed-egress electromagnetic lock(s) .
4) Quantity as indicated on Drawings of electromechanical lock(s) .
5) Quantity as indicated on Drawings of self-contained electronic lock(s) .
6) Quantity as indicated on Drawings of exit lock(s) and alarm(s)
7) Quantity as indicated on Drawings of auxiliary electrified door hardware
8) Quantity as indicated on Drawings of door operator controls.
9) Quantity as indicated on Drawings of panic exit device(s) with electric strike .

d. Integrated Credential Readers and Entry Management:

1) Quantity as indicated on Drawings of swipe card reader(s) .
2) Quantity as indicated on Drawings o card reader(s).
3) [Quantity as indicated on Drawings of proximity reader(s) for card, fob, or smartphone .
4) Quantity as indicated on Drawings of proximity card reader(s) for hazardous (classified) location.
5) Quantity as indicated on Drawings of door lock keypad(s).
6) [Quantity as indicated on Drawings of scramble keypad(s) specified in Section 281511 "Integrated Credential Readers and Entry Management."
7) Quantity as indicated on Drawings of combination card reader(s) and keypad(s) specified in Section 281511 "Integrated Credential Readers and Entry Management."

e. Egress Management Devices:

1) Quantity as indicated on Drawings of magnetic lock hardware with special locking arrangement
2) Quantity as indicated on Drawings of panic hardware with special locking arrangement .

D. Special Techniques:

1. Comply with manufacturer's published instructions.
2. Mounting Heights: Mount field devices in accessible locations in accordance with United States Access Board ADA-ABA Accessibility Guidelines standards.

E. Systems Integration:
1. Coordinate with Section 282000 "Video Surveillance" for integrating access control system with video surveillance controls.

3.2 FIELD QUALITY CONTROL OF ACCESS CONTROL SYSTEM COMPONENTS

A. Field tests and inspections must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections for access control system components.
2. Perform industry standard tests and inspections for power supplies, batteries, and other standby power provisions.
3. Engage factory-authorized service representative to test end-to-end system connection and functionality.
4. Verify monitoring of access control system status and diagnostics information.

C. Nonconforming Work:

1. Access control equipment will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.3 PROTECTION

A. After installation, protect access control system components from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 28 10 00

SECTION 28 13 00 - ACCESS CONTROL SOFTWARE AND DATABASE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Software for access control system units.

B. Related Requirements:

1. Section 280010 "Supplemental Requirements for Electronic Safety and Security" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and instructions issued to Installer by manufacturer for the following:

1. Installation and programming instructions for operating system software, including all applicable software add-ons.
2. Manufacturer's recommended setup and testing procedure for operating system software and applicable software add-ons.
3. Troubleshooting instructions for operating system software and applicable software add-ons.
4. Installation and programming instructions for antivirus and security protection software.
5. Manufacturer's recommended setup and testing procedure for antivirus and security protection software.
6. Troubleshooting instructions for antivirus and security protection software.

PART 2 - PRODUCTS

2.1 SOFTWARE FOR ACCESS CONTROL SYSTEM UNITS

A. Description: This category covers software products intended for installation on access control system units.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70 and NFPA 72, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
b. Comply with NFPA 1, NFPA 730, NFPA 731, and ICC IBC.

2. Listing Criteria:

a. Cybersecurity: UL CCN CYBR; including UL 2900-1 and UL 2900-2-3.
b. Access Control System Functionality: UL CCN ALVY; including UL 294.
c. Hardware that Interfaces with Fire Alarm or Mass Notification: UL CCN UOJK; including UL 864.

C. Access Control System Unit Operating System Software:

1. Additional Characteristics:

a. Provides event logging, notification, and escalation.
b. Provides threat-level management and response actions.
c. Provides dashboard view of system health and status.
d. Maintains credential-driven user records and access history.
e. Supports network-connected credential readers and controlled doors.
f. Supports add-on software.
g. Supports video-surveillance system integration.
h. Provides email alerts.

D. Access Control System Unit Antivirus and Security Protection Software:

1. Additional Characteristics:

a. Endpoint detection and response.
b. Anti-ransomware.
c. Managed threat response.
d. Exploit prevention.
e. Active adversary mitigations.
f. Email alerts.

E. Visitor Management Database Software:

1. Additional Characteristics:

a. Visitor registration.
b. Visitor audit trails and reporting.
c. Badge printing.
d. Unassisted visitor registration and badging.
e. Preconfigured security levels of users.
f. Filters out unsolicited visitors.
g. Supports integrated credential readers.

2. Options:

a. Automated Alerts:

1) Visitor check-in.
2) Package check-in.
3) Watch list alert.
4) Expired badges.
5) Panic message.

6) Current visitor.
7) Maximum visitor.
8) Frequent visitor.
9) Time based.

F. Mobile Credential Validation Database Software:
1. Additional Characteristics:

a. Mobile Validator and Mobile Registration engines.
b. Network-based functionality and database synchronization.
c. Credential audit trail exporting.
d. Contact or contactless verification.
e. Integrated card reader.
f. Biometric finger scanner.

2. Options:
a. Credentials:

1) PIV.
2) PIV-1.
3) TWIC.
4) FRAC.
5) CAC.
6) CIV.
7) Prox.
8) DESFire.

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESS CONTROL SOFTWARE

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Installation of Access Control Software: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with requirements in guide information for UL CCN ALVY, UL CCN CYBR, and UL CCN UOJK.
2. Consult Architect for resolution of conflicting requirements.

C. Interfaces with Other Work:

1. Coordinate with Section 281000 "Access Control" for physical and functional interfaces with access control system and for compliance with system-wide performance requirements.
2. Coordinate with Section 281400 "Access Control System Hardware" for products that require access control software specified in this Section for operation and compliance with system-wide performance requirements.

3.2 FIELD QUALITY CONTROL OF ACCESS CONTROL SOFTWARE

A. Acceptance Testing Preparation:

B. Field tests and inspections must be witnessed by authorities having jurisdiction.

C. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.

D. Nonconforming Work:

1. Software will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective software and retest.

E. Collect, assemble, and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 28 13 00

SECTION 281400 - ACCESS CONTROL SYSTEM HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access control system units.
2. Access control system power supplies and battery chargers.

B. Related Requirements:

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1. Section 280010 "Supplemental Requirements for Electronic Safety and Security" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Coordination Meeting(s): For access control system hardware. Conduct meeting(s) as videoconference or at Project site before installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Access control system units.
2. Access control system power supplies and battery chargers.

B. Shop Drawings:

1. Project general notes.
2. Hardware and equipment locations.
3. Block diagram and cable/conduit routing.
4. System communications details.
5. Hardware and equipment installation details.
6. Secondary power calculations.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installation instructions for access control system servers.
2. Installation instructions for access control system DGPs.
3. Installation instructions for access control system input/output interface.

4. Installation instructions for access control system door controllers.
5. Manufacturer's recommended testing and inspection procedure for operation of access control system servers, panels, input/output interfaces, and door controllers.
6. Installation instructions for access control system power supplies and battery chargers.
7. Manufacturer's recommended testing and inspection procedure for operation of access control system power supplies and battery chargers.

B. Sample warranties.

PART 2 - PRODUCTS

2.1 ACCESS CONTROL SYSTEM UNITS

A. Description: This category covers head end units for access control systems, providing a means of regulating or controlling physical entry into an area, or access to or use of device by electrical, electronic, and/or mechanical means. Access control systems are investigated as complete configuration based upon manufacturer's specified system components. Access control systems are intended to comply with applicable life safety access and egress requirements.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70 and NFPA 72, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
b. Comply with NFPA 1, NFPA 730, NFPA 731, and ICC IBC.

2. Listing Criteria: UL CCN ALVY; including UL 294.

C. Access Control System Server :

1. Additional Characteristics:

a. Ethernet port for connection to LAN/WAN.
b. Mounting: EIA/ECA-310 standard 19 inch rack mount

2. Accessories:

a. DIN rails for mounting.

D. Access Control System Data Gathering Panels :
1. Additional Characteristics:

a. Data ports for connection to LAN and downstream DGPs.
b. Integral terminal blocks secured to enclosure.
c. Enclosure lock with tamper switch and monitoring.

E. Access Control System Door Controllers
1. Additional Characteristics:

a. Data ports for connection to LAN and downstream controllers.
b. Integral terminal blocks for connection of inputs/outputs to field devices.
c. Controller Inputs:

1) Auxiliary input.
2) Door contact.
3) Request to exit.
4) Cabinet tamper.
5) Power monitor.

d. Controller Outputs:

1) Auxiliary output.
2) Door strike.
3) Door operators.
4) Credential readers.

F. Access Control System Input/Output Interface
1. Additional Characteristics:

a. Input Voltage: 12 to 24 V(dc)
b. Operating Temperature: 32 to 158 deg F
c. Data ports for connection to LAN and downstream panels/controllers.
d. Integral terminal blocks for connection of inputs/outputs to field devices.
e. Inputs:

1) Auxiliary inputs from building systems.
2) Door contact.
3) Request to exit.
4) Cabinet tamper.
5) Power monitor.

f. Outputs:

1) Auxiliary outputs to building systems.
2) Door strike.
3) Credential readers.
4) Audible devices.

2. Options:

a. Communication: Ethernet
b. Mounting: Rack mount

2.2 ACCESS CONTROL SYSTEM POWER SUPPLIES AND BATTERY CHARGERS

A. Description: This category covers power supplies and battery chargers for access control system units, controllers, input/output interfaces, workstations, printers, and encoders.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70 and NFPA 72, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
b. Comply with NFPA 1, NFPA 730, NFPA 731, and ICC IBC.

2. Listing Criteria: UL CCN ALVY; including UL 294.

C. Access Control System Power Supply and Battery Charger :
1. Additional Characteristics:

a. Input Voltage: 120 V(ac)
b. Output Voltage: 12 to 24 V(dc)
c. Operating Temperature: 32 to 120 deg F
d. Network connection for remote supervision, management, and testing.
e. Enclosure lock with tamper switch and monitoring.
f. Built-in battery charger.

2. Options:
a. Mounting: Rack mount

3. Accessories:

a. DIN rails for mounting.

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESS CONTROL SYSTEM HARDWARE

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Installation of Access Control System Hardware and Wiring: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with requirements in guide information for UL CCN ALVY.
2. Consult Architect for resolution of conflicting requirements.

C. Interfaces with Other Work:

1. Coordinate installation of new products for access control system hardware with existing conditions.

2. Coordinate with Section 281000 "Access Control" for physical and functional interfaces with access control system and for compliance with system-wide performance requirements.

3.2 FIELD QUALITY CONTROL OF ACCESS CONTROL SYSTEM HARDWARE

A. Acceptance Testing Preparation:

B. Field tests and inspections must be witnessed by authorities having jurisdiction

C. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.

D. Nonconforming Work:

1. Hardware and components will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.3 PROTECTION

A. After installation, protect access control system hardware from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 28 14 00

SECTION 28 15 15 - ELECTRIFIED LOCKING DEVICES AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrically controlled single-point locks and latches.
2. Electrically controlled three-point locks and latches.
3. High-security electronic locks.
4. Status monitoring and egress devices.

B. Related Requirements:

1. Section 280010 "Supplemental Requirements for Electronic Safety and Security" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Coordination Meeting(s): For electrified locking devices and accessories. Conduct meeting(s) as videoconference or at Project site before installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Electrically controlled single-point locks and latches.
2. Electrically controlled three-point locks and latches.
3. High-security electronic locks.
4. Status monitoring and egress devices.

B. Shop Drawings:

1. Project general notes.
2. Device layout.
3. Block diagram and cable/conduit routing.
4. System communications details.
5. System mounting details.
6. Secondary power calculations.

PART 2 - PRODUCTS

2.1 ELECTRICALLY CONTROLLED SINGLE-POINT LOCKS AND LATCHES

A. Description: This category covers single-point electrified locksets, including cylindrical and mortise-style locks, which are connected to the access control system via hardwired cabling or wireless. Electrified locksets communicate with credential readers through the access control system to unlock doors upon credential authorization. Electrified locksets may also be programmed to lock or unlock directly via a signal from the access control system without the need for credential authorization.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:

a. Special Locking Arrangements: UL CCN FWAX; including UL 294, NFPA 101, and ICC IBC.
b. Electrically Controlled Single-Point Locks and Latches: UL CCN GYQS, UL 10B, and UL 10C; designed to be used with Class 2 control-voltage circuits in accordance with Article 725 of NFPA 70.

2.2 HIGH-SECURITY ELECTRONIC LOCKS

A. Description: This category covers high-security electronic locks, which are connected to the access control system via hardwired cabling or wireless. High-security electronic locks typically have multilevel authentication or utilize heavy-duty components for increased security.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:

a. Special Locking Arrangements: UL CCN FWAX; including UL 294, NFPA 101, and ICC IBC.
b. High-Security Electronic Locks: UL CCN OZDC; including UL Subject 2058.

2.3 STATUS MONITORING AND EGRESS DEVICES

A. Description: This category covers egress devices and sensors, which are installed integral to or adjacent to door assemblies. Equipment under this category may be interconnected to other access control equipment, such as credential readers and locking devices. Equipment under this category may also be directly connected to the access control system to report door status.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN ALVY; including UL 294.

C. Request-to-Exit (REX) Motion Sensor :
1. Options:

a. Input Power: 125 V(ac)
b. Operating Temperature: Minus 13 to plus 140 deg F
c. Sensing Technology Passive infrared (PIR)
d. Color: White
e. Mounting: Wall surface or Door frame.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. Cable Type: Shielded

C. Protection: After installation, protect electrified locking devices and accessories from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

B. Field tests and inspections must be witnessed by authorities having jurisdiction

C. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.

D. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 28 15 15

SECTION 28 15 17 - EGRESS MANAGEMENT DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Magnetic lock hardware with special locking arrangement for fire-rated doors.
2. Panic hardware with special locking arrangement for fire-rated doors.

B. Related Requirements:

1. Section 280010 "Supplemental Requirements for Electronic Safety and Security" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Coordination Meeting(s): For egress management devices. Conduct meeting(s) as videoconference or at Project site before installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Magnetic lock hardware with special locking arrangement.
2. Panic hardware with special locking arrangement.

B. Shop Drawings:

1. Project general notes.
2. Device layout.
3. Block diagram and cable/conduit routing.
4. System communications details.
5. System mounting details.
6. Secondary power calculations.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installation instructions for egress management devices.
2. Manufacturer's recommended tests and inspections for egress management devices.

1.5 REGULATORY AGENCY APPROVALS

A. Submittals for egress management devices require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MAGNETIC LOCK HARDWARE WITH SPECIAL LOCKING ARRANGEMENT FOR FIRE-RATED DOORS

A. Description: Magnetic lock connected to access control system and programmed for desired function. Magnetic lock may be programmed for release by access control system. Magnetic lock may also be pressure sensing, programmed to release and alarm after pressure is applied for a designated period.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
b. Compliant with NFPA 101, ICC IBC, and local life safety code requirements for use along means of egress.

2. Listing Criteria:

a. Special Locking Arrangements: UL CCN FWAX or UL CCN FWAX2; including UL 294, NFPA 101, and ICC IBC.
b. Electromagnetic Locks for Fire-Rated Doors: UL CCN GWXT; including UL 10B and UL 10C.

2.2 PANIC HARDWARE WITH SPECIAL LOCKING ARRANGEMENT FOR FIRE-RATED DOORS

A. Description: This category covers devices mounted on outward-swinging exit doors to facilitate egress. When activated, devices monitor against unauthorized egress and allow exiting after specified time delay. These devices allow immediate exit in case of power failure or upon activation of fire-alarm system.

1.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
b. Compliant with NFPA 101, ICC IBC, and local life safety code requirements for use along means of egress.

2. Listing Criteria:

a. Special Locking Arrangements: UL CCN FWAX or UL CCN FWAX2; including UL 294, NFPA 101, and ICC IBC.
b. Panic Hardware for Fire-Rated Doors: UL CCN GXHX, UL 10C, and UL 305.
c. Controlled-Exit Panic Devices: UL CCN FULA; including UL 305.

C. Options:

1. Input Voltage: 12 to 24 V(dc)
2. Release Delay:(0-15) seconds.
3. Door Prop Alarm: Optional
4. Dry contact for external alarm relay to security system
5. Secondary Power: Battery Backup

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Interfaces with Other Work:

1. Coordinate installation of new products for egress management devices with existing conditions.

2. Coordinate with Section 282000 "Video Surveillance" for coordination of automatic video feed callup upon delayed egress activation.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

B. Field tests and inspections must be witnessed by authorities having jurisdiction.

C. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.

D. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 28 15 17

SECTION 28 15 19 - ACCESS CONTROL REMOTE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Near Field Communications (NFC) access control devices.

B. Related Requirements:

1. Section 280010 "Supplemental Requirements for Electronic Safety and Security" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Coordination Meeting(s): For access control remote devices. Conduct meeting(s) as videoconference or at Project site before installation>.

1.3 ACTION SUBMITTALS

A. Product Data:

1. NFC access control devices.

B. Shop Drawings:

1. Project general notes.
2. Device layout.
3. Block diagram and cable/conduit routing.
4. System communications details.
5. System mounting details.
6. Secondary power calculations.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installation instructions for access control remote devices.
2. Manufacturer's recommended tests and inspections for access control remote devices.

PART 2 - PRODUCTS

2.1 NEAR FIELD COMMUNICATIONS (NFC) ACCESS CONTROL DEVICES

A. Description: This category includes access control devices that use NFC technology to transmit data over short distances. Data may be transmitted between proximity card, fob, or smartphone and NFC-enabled credential readers.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN ALVY; including UL 294.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. Cable Type: Shielded
2. Maximum Cable Length: 300 ft

C. Protection: After installation, protect access control remote devices from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

B. Field tests and inspections must be witnessed by authorities having jurisdiction

C. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.

D. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Collect, assemble, and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 28 15 19

SECTION 28 20 00 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.

B. Related Requirements:

1. Section 281300 "Access Control System Software and Database Management" to integrate access control system interface and control.
2. Section 283100 "Intrusion Detection" to integrate video surveillance used for intrusion detection.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
1. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
2. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
3. Wiring Diagrams: For power, signal, and control wiring.

1.3 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
2. Interior, Controlled Environment: System components, except central-station control unit, installed in [temperature-controlled] interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
3. Interior, Uncontrolled Environment: System components installed in non- [temperature-controlled] interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 3R enclosures.
4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph. Use NEMA 250, Type 3R enclosures.

5. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.

B. Surge Protection: Protect components from voltage surges entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.

C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 STANDARD CAMERAS

A. Color Camera:
1. Pickup Device: CCD interline transfer, 380,000, 771(H) by 492(V), pixels.
2. Horizontal Resolution: 480 lines.
3. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
4. With AGC, manually selectable on or off.
5. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
6. Manually selectable modes for backlight compensation or normal lighting.
7. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
8. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
9. Motion Detector: Built-in digital.

B. Automatic Color Dome Camera: Assembled and tested as a manufactured unit, containing dome assembly, color camera, motorized pan and tilt, zoom lens, and receiver/driver.
1. Pickup Device: CCD interline transfer, 380,000, 768(H) by 494(V**)** pixels.
2. Horizontal Resolution: 480 lines.
3. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
4. With AGC, manually selectable on or off.
5. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
6. Manually selectable modes for backlight compensation or normal lighting.
7. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.
8. Preset Positioning: Eight user-definable scenes, each allowing 16-character titles. Controls shall include the following:

a. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.
b. Motion detection shall be available at each camera position.
c. Up to four preset positions may be selected to be activated by an alarm. Each of the alarm positions may be programmed to output a response signal.

9. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
10. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
11. Motion Detector: Built-in digital.
12. Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.

2.3 LENSES

A. Description: Optical-quality coated lens, designed specifically for video-surveillance applications and matched to specified camera. Provide color-corrected lenses.

1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
2. Fixed Lens: With calibrated focus ring.
3. Zoom Lens: Motorized, remote-controlled unit, rated as "quiet operating." Features include the following:

a. Electrical Leads: Filtered to minimize video signal interference.
b. Motor Speed: Variable.
c. Lens shall be available with preset positioning capability to recall the position of specific scenes.

2.4 POWER SUPPLIES

A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera and lens.

1. Enclosure: NEMA 250, Type 3

2.5 CAMERA-SUPPORTING EQUIPMENT

A. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.

1. Panning Rotation: 0 to 355 degrees, with adjustable stops.
2. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.
3. Speed: 12 degrees per second in both horizontal and vertical planes.
4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
5. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.

2.6 DIGITAL VIDEO RECORDERS

A. Description: Digital, time-lapse type, full-frame and motion recorder, with removable hard drive.

1. Recording Time: Defined by owner.
2. Resolution: 720 by 480 lines, minimum.
3. Programming shall be from trackball and push buttons on face of the recorder, settings shall be displayed on any video monitor connected to the recorder. Programming shall include the following:

    a. Motion analysis graph.
    b. Password protection.
    c. Alarm and timer controls.
    d. Continuous recording option.
    e. Time-lapse operating modes.
    f. Search video by time, event, or motion.

4. Programming: SmartMedia card for software updating, image archiving, and image transfer to a PC.
5. Storage: sized appropriate for owner required CCTV playback, removable hard drive. Software shall permit hot-swapping drives.
6. Compression: H.264 or MPEG-4
7. Time and Date Generator: Records time (hr:min:sec) and date legend of each frame.
8. Audio Recording: 70 to 7000 Hz. Phono and microphone input; phono output.
9. Mounting: Standard 19-inch rack complying with CEA 310-E, or freestanding desktop.

2.7 NETWORK VIDEO RECORDERS

A.

1. Video and audio recording over TCP/IP network.
2. Video recording of H.264 and MPEG-4 streams.
3. Video recording up to 48 Mbps for internal storage and up to 100 Mbps for external storage.
4. Duplex Operation: Simultaneous recording and playback.
5. Continuous and alarm-based recording.
6. Full-Featured Search Capabilities: Search based on camera, time, or date.
7. Automatic data replenishment to ensure recording even if network is down.
8. Digital certification by watermarking.
9. Internal RAID storage or non-RAID storage of up to 1500 GB.
10. Capable of adding external RAID storage up to 7000 GB for models with no internal storage.
11. Full integration with LAN, Intranet, or Internet through standard Web browser or video management software.
12. Integrated Web server FTP server functionality.
13. Supports up to 64 devices.

2.8 DIGITAL SWITCHERS

A. Quad Switch: For displaying images from four cameras on a single monitor. Provide color switcher.

1. Controls: Unit-mounted front panel.

2. Resolution: 720 by 480 lines
3. Modes: Auto, manual, and alarm. In manual mode, each channel can also be viewed in single display mode. In the event of an alarm, alarming channel shall automatically switch to full screen. If several alarms are activated, channels in alarm shall be in auto-switching mode.
4. Channel Loss Alarm: Audible buzzer; occurrence details shall be recorded.
5. Time: Indicate date and time.
6. Timing of Auto-Switcher: 1 to 30 seconds, selectable.
7. Mounting: Standard 19-inch rack complying with CEA 310-E, or freestanding desktop.

B. Manual Switch Bank: Low-loss, high-isolation, multiple-video switch to allow manual switching of multiple quad switches and cameras to a single output. Switches shall be illuminated.

C. Sequential Switchers: Automatically sequence outputs of multiple cameras to single monitor.

1. Switching Time Interval: Continuously adjustable, 5 to 20 seconds minimum, with manual override.
2. Skip-Sequential-Hold Switch: One for each camera, with LED to indicate active camera.
3. Camera Identification Legend: Either on-screen message or label at skip-sequential switch.
4. Alarm Switching: In the event of an alarm, alarming channel shall automatically switch the monitor to full screen.
5. Mounting: Standard 19-inch rack complying with CEA 310-E.

2.9 IP VIDEO SYSTEMS

A. Description:

1. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.
2. System shall have seamless integration of all video surveillance and control functions.
3. Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.
4. System design shall include all necessary compression software for high-performance, dual-stream, MPEG-2/MPEG-4 video. Unit shall provide connections for all video cameras, camera PTZ control data, bidirectional audio, discreet sensor inputs, and control system outputs.
5. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software.
6. Camera system units shall be ruggedly built and designed for extreme adverse environments, complying with NEMA Type environmental standards.
7. Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN.
8. All system interconnect cables, workstation PCs, PTZ joysticks, and network intermediate devices shall be provided for full performance of specified system.

2.10 VIDEO MOTION SENSORS (INTERIOR)

A. Device Performance: Detect changes in video signal within a user-defined protected zone. Video inputs shall be composite video as defined in SMPTE 170M. Provide an alarm output for each video input.

1. Detect movement within protected zone of intruders wearing clothing with a reflectivity that differs from that of background scene by a factor of two. Reject all other changes in video signal.
2. Modular design that allows for expansion or modification of number of inputs.
3. Controls:

    a. Size of detection zones.
    b. Sensitivity of detection of each protected zone.

4. Mounting: Standard 19-inch rack complying with CEA 310-E.

2.11 CONTROL STATIONS

A. Description: Heavy-duty, freestanding, modular, metal furniture units arranged to house electronic equipment. Coordinate component arrangement and wiring with components and wiring of other systems.

B. Equipment Mounting: Standard 19-inch rack complying with CEA 310-E.

C. Normal System Power Supply: 120 V, 60 Hz, through a locked disconnect device and an isolation transformer in central-station control unit. Central-station control unit shall supply power to all components connected to it unless otherwise indicated.

D. Power Continuity for Control Station: Batteries in power supplies of central-station control units and individual system components shall maintain continuous system operation during outages of both normal and backup ac system supply.

1. Batteries: Rechargeable, valve-regulated, recombinant, sealed, lead-acid type with nominal 10-year life expectancy. Capacity adequate to operate portions of system served including audible trouble signal devices for up to four hours and audible and visual alarm devices under alarm conditions for an additional 10 minutes.
2. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Charger shall recharge fully discharged battery within 24 hours.

E. Annunciation: Indicate change in system condition and switching of system or component to backup power.

2.12 SIGNAL TRANSMISSION COMPONENTS

A. Cable: Coaxial cable elements have 75-ohm nominal impedance.

B. Video Surveillance Coaxial Cable Connectors: BNC type, 75 ohms.

PART 3 - EXECUTION

3.1 WIRING

A. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

B. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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.

C. For communication wiring, comply with the following:

1. Section 271313 "Communications Copper Backbone Cabling."
2. Section 271323 "Communications Optical Fiber Backbone Cabling."
3. Section 271513 "Communications Copper Horizontal Cabling."
4. Section 271523 "Communications Optical Fiber Horizontal Cabling."

3.2 SYSTEM INSTALLATION

A. Install cameras with 84-inch-minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

B. Set pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.

C. Avoid ground loops by making ground connections only at the control station.

1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.

END OF SECTION 28 20 00