PROJECT MANUAL

L'DOR ASSISTED LIVING

WEST CLARKSTOWN ROAD
NEW CITY, NEW YORK 10956

OWNER:
FRIENDSHIP VENTURES, LLC
32 PINE TREE DRIVE
POUGHKEEPSIE, NEW YORK 12603

ARCHITECT:
HARRIS A. SANDERS, ARCHITECTS, P.C.
252 WASHINGTON AVENUE
ALBANY, NEW YORK 12210

BID SET
SEPTEMBER 18, 2020

L'Dor Assisted Living
West Clarkstown Road, New City, NY

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AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)
L'Dor Assisted Living
West Clarkstown Road, New City, New York

THE OWNER:
(Name, legal status and address)
Friendship Ventures, LLC
32 Pine Tree Drive
Poughkeepsie, NY 12603

THE ARCHITECT:
(Name, legal status and address)
Harris A. Sanders Architects, P.C.
252 Washington Ave.
Albany, New York 12210

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

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

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 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.

SUPPLEMENTAL GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, AIA Document A201 and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

1.1 Should any conflict be found in or between the Contract Documents, the Contractor/Construction Manager may be deemed to have estimated on the most expensive way of doing the work, unless, prior to submission of his bid, he shall have asked for a decision from the Architect as to which shall govern. The Architect, in case of such conflict, may interpret the Contract documents so as to secure in all cases the most substantial and complete performance.

1.2 All dimensions shall be verified by the Contractor by measurements at the job site and he shall take any and all measurements necessary to verify the Drawings and to properly lay out his work.

1.3 The Contractor/Construction Manager or each Subcontractor whose work is attached to, superimposed upon, or dependent upon the work of other trades of Contractors shall inspect all surface and conditions of the work to which he attaches, etc., and shall report defects in same to the Architect. Beginning of work constitutes acceptance by the Contractor of the surfaces to which he attaches work. Failure to report defects in advance obligates the Contractor to pay for the removal and replacement of work in place if required to correct the defect.

1.4 The following is a summary of applicable provisions of the New York State Labor Law. This law shall be a part of this contract as though written in full.

1.5 Labor Provisions

A. Nondiscrimination in Employment

1. In the hiring of employees for the performance of work under the contract or any subcontract thereunder, neither the Contractor/Construction Manager, nor any subcontractor nor any person acting on behalf of the contractor or any subcontractor, shall by reason of race, creed, color or national origin discriminate against any person who is qualified or available to perform work to which the employment relates.

2. Neither the Contractor/Construction Manager nor any subcontractor nor any person acting on behalf of the Contractor or any subcontractor shall in any way or manner discriminate against or intimidate any employee hired for the performance of the work covered by the Contract on account of race, creed, color or national origin. (Your attention is also directed to the provisions of the state Law against Discrimination which prohibit discrimination in employment because of age, sex or marital status.)

1.6 Each subcontractor at their own expense shall provide insurance for not less than the following, or greater if required by law:

Insurance Requirements

The Contractor and its Subcontractors, at their own expense, shall purchase and maintain insurance of the following types of coverage and limits of liability through insurance carriers licensed to provide insurance in the State of New York and have an A. M. Best Company rating of "A-" or better. These insurances shall be maintained by the Contractor and its Subcontractors prior to the earlier of the commencement of work or the effective date of the Contract, whichever comes first, through and including any warranty period along with and including any Completed Operations requirements.

Failure for the Owner to identify deficiencies in any insurance provided by Contractor shall not relieve Contractor from any insurance obligations.

1) Commercial General Liability (CGL)
   a) CGL with limits of Insurance of not less than $1,000,000 each occurrence and $2,000,000 Annual Aggregate.
   b) CGL coverage shall be written on ISO Occurrence form CG 00 01 1001 or a substitute form providing equivalent coverage and shall cover liability arising out of, caused in whole or part by or resulting from premises, operations, products, completed operations, personal & advertising injury and independent contractors as well as liability assumed in a Contract including the Tort Liability of another assumed in a contract.
   c) The policy shall be endorsed for the General Aggregate to apply separately to each project.
   d) Friendship Ventures, LLC, PAZ Management, Inc. and L'Dor Assisted Living, LLC and all other parties required of the Contractor, shall be included as insureds/Additional Insureds on the CGL, using ISO Additional Insured

Endorsement CG 20 10 11 85 or CG 20 10 10 01 and CG 20 37 10 01 or endorsements providing equivalent coverage to the Additional Insureds for both on-going operations and completed operations. This insurance for the Additional Insureds shall be as broad as the coverage provided for the named insured Contractor. Additional Insured policy language must extend beyond standard blanket Additional Insured endorsements to include parties with whom Contractor does not have a direct contract including but not limited to the Owners, Architect/Engineers, Construction Managers, and all other parties required of the Contractor. Coverage for the Additional Insureds shall apply as primary insurance (hereinafter called "Primary") before any other insurance or self-insurance, including any deductible, maintained by, or provided to the Additional Insureds and shall not require the contribution of any of the insurances available to the Additional Insureds (hereinafter called "Non-Contributory evidenced by ISO Endorsement Form CG 20 01 04 13 or equivalent).

e) Contractor shall maintain CGL coverage for itself and all Additional Insureds for the duration of the project and maintain Completed Operations coverage for itself and each Additional Insured for at least 3 years after completion of the Work.

2) Riggers Liability

If the Scope of work involves rigging, hoisting, lowering, raising or moving of property or equipment not belonging to the Contractor, Rigging Liability Insurance is required to insure for the full value of the property or equipment against physical damage/loss.

3) Automobile Liability

a) Business Auto Liability with limits of at least $1,000,000 each accident.
b) Business Auto coverage must include coverage for liability arising out of all owned, leased, hired and non-owned automobiles.
c) Business Auto coverage must include as insureds all entities that are Additional Insureds on the CGL.
d) Auto coverage for the Additional Insureds shall apply as Primary and Non-Contributory.
e) If scope of work includes Hauling/Transporting Hazardous Materials, any Business Auto Liability policy covering vehicles not licensed by the New York State Department of Motor Vehicles must be endorsed with an MCS 90 Endorsement and ISO Form CA9948 (Pollution Liability Broadened Coverage for Business Automobile).

4) Commercial Umbrella

a) Umbrella limits must be at least $10,000,000.
b) Umbrella coverage must include as insureds all entities that are Additional Insureds on the CGL.
c) Umbrella coverage for such Additional Insureds shall apply as Primary and Non-contributory before any other insurance or self-insurance, including any deductible, maintained by, or provided to the Additional Insured or indemnities parties other than the CGL, Auto Liability and Employers Liability coverages maintained by the Contractor.
d) Umbrella Coverage shall be as broad as the Primary coverage in 1, 2 and 3 above.

5) Workers Compensation and Employers Liability

a) Statutory Coverage for all employees including those statutorily exempt - i.e. - Sole Proprietors, Partners, Limited Liability Members or Executive Officers.
b) Coverage limits must be at least $1,000,000 each accident for bodily injury by accident and $1,000,000 each employee for injury by disease.
c) Where applicable, U.S. Longshore & Harborworkers Compensation Act, Maritime Coverage and Voluntary Compensation Endorsements shall be attached to the policy.
d) As required by the New York State Workers Compensation Law, all out of state Contractors working in New York must provide a Workers Compensation Insurance Policy that specifically lists New York in Item 3A of the Policy Information page. Coverage limits must be at least $1,000,000 each accident for bodily injury by accident and $1,000,000 each employee for injury by disease.

6) Pollution Liability

If the Scope of the work performed by the Contractor or Subcontractors include the handling, removal, abatement or disposal of Hazardous Materials, the Contractor must maintain:

a) Pollution Liability coverage of at least $2,000,000 per occurrence and $2,000,000 Aggregate, such aggregate must be applicable on a Per Project Basis,
b) Coverage must be maintained for the duration of the project and for a period of two years after the completion of the contract,
c) Owner and all other parties required of the Contractor, shall be included as insureds on the policy on a primary and non-contributory basis for ongoing and completed operations,
d) Coverage shall provide pollution liability coverage for covered autos (endorsement 99 48) as well as proof of MCS 90.
e) Coverage for Non-owned Disposal Site Liability.

7) Property

Property Insurance coverage for the Contractor's materials, tools and equipment on or off the project site, in transit or in storage for amounts sufficient enough to protect the Contractor. Coverage shall include Testing and /or Commissioning of equipment, whether by Contractor or by Subcontractor or Vendor. Failure to provide this coverage will not relieve Contractor and/or its Subcontractors or Vendor from Liability.

Waiver of Subrogation

All insurance policies maintained by the Contractor shall include a waiver of any and all rights of subrogation of the Contractor or its Insurers against Owner along with all other Additional Insureds / Indemnified Parties and their agents, officers, directors and employees for recovery of damages. Contractor further waives its right of subrogation against the Owner or any Additional Insured or Indemnified Party for any damage or loss to the Contractor's scope of work, tools, equipment, materials or any other loss within the scope of any insurance maintained by Contractor.

Notice of Cancelation

All insurance coverage required herein shall be endorsed that the Insurer providing such coverage shall provide Owner thirty (30) days notice of non-renewal or ten (10) days notice of cancellation. In the event the Insurer is unable to provide such endorsement, the Contractor agrees that it is their responsibility to provide such notice to the Owner as soon as practically possible but in no event more than seven (7) days from when they receive notice of the non-renewal or cancelation. Failures to do so shall constitute of Breach of Contract allowing the Owner to terminate the Contract and suspend all payments until such time that the Contractor has provided evidence that the affected coverage have been reinstated or replaced as of the date of non-renewal or cancelation.

No Limitation

The insurance coverages outlined in this agreement or maintained by the Contractor shall not be interpreted to limit any of the Contractor's indemnity obligations or other liabilities under this Contract. Insurance coverages maintained by the Contractor that exceed the minimum requirements of this agreement shall be applicable to this Contract.

Certificate / Evidences of Insurance

A certificates of insurance (Acord 25 and Acord 855) shall be provided reflecting The Project Name and "all work performed by the Contractor for the Owner" and all of the above coverages. Copies of Endorsements reflecting Additional Insured status, Primary and Non-Contributory Coverage, Waiver of Subrogation and Notice of Cancellation/Change on the above policies must be attached to the Certificate of Insurance. Copies of Policies must be provided upon request. Failure to provide the necessary coverages, Certificates and Endorsements or Policies will preclude any payments from being made to the Contractor and constitute a Breach of Contract allowing owner to terminate of the Contract.

Please be sure to reference Project Name in the description of operations on certificate of insurance.

See 4.18 of General Conditions AIA Document A201 and 11.11.1 of AIA Document A401 Subcontractor and extend 11.20 to read:

Indemnity by Subcontractor

The Subcontractor shall, to the fullest extent permitted by Law, indemnify and hold harmless the Contractor/Construction Manager, Architect, and Owner and all of his agents and employees from and against all claims, damages, losses, and expenses including attorney's fees arising out or resulting from the performance of the Subcontractor's work under the Subcontract, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, sickness, disease, or death, or to injury due to or destruction of tangible property (other than the work itself), including the loss of use resulting therefrom and (b) is caused in whole or in part by any negligent act or omission of the Subcontractor or anyone directly or indirectly employed by his or anyone for whose acts he may be liable, regardless of whether it is caused in part by party indemnified hereunder.

Property Damage Liability Insurance - Blasting, Explosion, Underground and Collapse:

1. The Subcontractor shall not discharge explosives until satisfactory evidence has been submitted to the Contractor/Construction Manager, Owner and Architect that his Property Damage Liability Insurance covers injury to or destruction of property resulting from blasting or explosion.

2. In the event the Subcontractor's operations involve the use of the mechanical equipment for excavating or drilling in streets or highways, such work shall not be undertaken until satisfactory evidence has been submitted to the Contractor, Owner and Architect that his Property Damage Liability Insurance covers injury to or destruction of property such as conduits, wires, pipes, sewers and the like, below and surface of the ground.

3. In the event that the contract includes excavation near the site of an existing structure, demolition of a building or structure, pile driving, shoring, underpinning or raising any building, such operations will not be commenced until evidence has been submitted to the Contractor, Owner and Architect that the Subcontractors Property Damage Liability Insurance included coverage for collapse of or structural injury to any building or structure from such operations.

8.3.2 Delete this paragraph and substitute the following:

If Contractor is delayed in the performance of the Work by fire, flood, epidemic, strikes, unforeseen and unanticipated abnormal weather conditions, or acts of God, and such events cause delay to the critical path of the work then Contractor shall be entitled to an equitable adjustment in the Contract Time. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Section8.3.2, provided and such delays by fire, flood, epidemic, strikes, unforeseen and unanticipated abnormal weather conditions, or acts of God do not create additional cost to the Contractor. Should such delays create additional, actual, out of pocket costs to the Contractor, Contractor shall be entitled to reimbursement of such additional costs through an equitable adjustment in the Contract Sum, provided that any such additional costs shall be approved by Owner.

8.3.3 Delete this paragraph and substitute the following:

Contractor shall not be entitled to an adjustment in the Contract Sum or the Contract Time for delays caused by and/or within control of Contractor. Whenever the Work falls behind schedule per the latest approved Construction Schedule due to the fault of the Contractor, its Subcontractors, suppliers or other parties for which Contractor is responsible, the Contractor shall, to the extent necessary to complete the Work within the Contract Time and/or comply with the approved Construction Schedule, increase its labor force and/or provide overtime, extra shifts, Saturday and Sunday and/or holiday work, and shall have its Subcontractors, suppliers or other parties for which Contractor is responsible do likewise, all at no additional cost to or compensation from the Owner. Further, the Owner shall have the right to supplement the Contractor's forces at the Contractor's expense to overcome any such delays; provided, however, in no event shall supplementation occur until after the Contractor receives written notice of the Owner's intent to supplement and has a period of five (5) days following the receipt of such notice to cure. Owner is entitled to deduct from the Contract Sum, any amounts then or thereafter due to the Contractor, or to be reimbursed by the Contractor for any reasonable additional costs to the Owner may incur as a result of said increase in supplemental labor force or overtime, extra shifts, Saturday, Sunday and/or holiday work. Delays attributable to and within the control of a Subcontractor, supplier or other parties for which Contractor is responsible shall be deemed to be delays within the control of Contractor.

8.3.4 Delete this paragraph and substitute the following:

The Owner may, in its sole discretion and for any reason, including recovery of lost time for delays outside Contractor's control, direct the Contractor to accelerate its Work by providing overtime, extra shifts, Saturday, Sunday and/or holiday work. In the event of overtime, extra shifts, Saturday, Sunday and/or holiday work by the Contractor's own forces or that of its Subcontractors, suppliers or other parties for which Contractor is responsible pursuant to this Section, Contractor shall receive an equitable adjustment for the increased costs occasioned thereby together with its fee on such costs pursuant to the portion of this Agreement relating to Changes in the Work.

11.1.3 Delete this paragraph and substitute the following:

The Subcontractor shall not commence work under this contract until he has obtained all the insurance required hereunder and such insurance has been approved by the Contractor/Construction Manager, Owner and Architect, nor shall the Contractor allow any Subcontractor to commence work on his subcontract until all similar insurance required of the Subcontractors has been obtained and approved.

All Certificates of Insurance must contain the following provision:

30 Days written notice by registered main shall be given to the Contractor, Owner and Architect prior to cancellation, material change or non-renewal of this insurance. Charter Concord Construction Inc. is named as an Additional Insured for all coverage. This insurance will apply as primary insurance and any other insurance issued to Charter Concord Construction Inc. shall apply as excess and non-contributing coverage.

Add the following to Article 11.

11.1.4 Any additional or other insurance which the Subcontractor or his Subcontractor requires for his own protection shall be his own responsibility and at his own expense.

If the Subcontractors fail to maintain continuance of the required insurance, the Contractor is entitled to provide protection for himself, to pay the premium, and to charge the cost to the Subcontractor.

The Subcontractor shall bear such risk or loss or damage until the work covered by contract has finally been accepted by the Owner or until complete removal of such plant, equipment, tools materials, or property from the construction site or vicinity thereof, whichever occurs last.

In the event of such loss or damage, the subcontractor shall forthwith repair or replace or maintain any such loss or damage without cost to the contractor.

Coverage Required

Subcontractor's Equipment Floater upon all tools and equipment required to be leased for the construction and completion of the work, including the interest of the Owner and the Lender.

If any of the work is sublet in any form from you as a Subcontractor, the Contractor/Construction Manager shall required each Subcontractor to carry Workers Compensation, General Liability, Business Auto and Excess Liability insurance with the same coverages.

END OF SECTION

SECTION 010001

BASIC REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Summary of Work:
   1. Contract.

B. Contract Considerations:
   1. Schedule of values.
   2. Applications for payment.
   3. Change procedures.

C. Coordination and Meetings:
   1. Coordination.
   2. Field engineering.
   3. Cutting and patching.
   4. Meetings.
   5. Progress meetings.
   6. Examination.
   7. Preparation.
   8. Cutting and Patching.

D. Submittals:
   1. Submittal procedures.
   2. Construction progress schedules.
   3. Proposed products list.
   4. Shop drawings.
   5. Product data.
   6. Samples.
   7. Manufacturers' installation instructions.
   8. Manufacturers' certificates.

E. Quality Control:
   1. Quality assurance - control of installation.
   2. Tolerances.
   3. References.
   4. Special Inspections and testing laboratory services.
   5. Manufacturers' field services and reports.

F. Construction Facilities and Temporary Controls:
   1. Temporary electricity.
   2. Temporary lighting for construction purposes.
   3. Temporary heat.
   4. Temporary ventilation.

5. Temporary water service.
6. Temporary sanitary facilities.
7. Barriers and fencing.
8. Water control.
9. Exterior enclosures.
10. Protection of installed work.
11. Security.
12. Maintenance of Traffic.
13. Parking.
14. Progress cleaning and waste removal.
15. Field offices and sheds.
16. Removal of utilities, facilities and controls.

G. Material and Equipment:
   1. Products.
   2. Transportation, handling, storage, and protection.
   3. Products options.
   4. Substitutions.
   5. Kitchen Equipment

H. Starting of Systems:
   1. Starting systems.
   2. Demonstration and instructions.
   3. Testing, adjusting and balancing.

I. Contract Closeout:
   1. Contract closeout procedures.
   2. Final cleaning.
   3. Adjusting.
   4. Project record documents.
   5. Operation and maintenance data.
   6. Spare parts and maintenance materials.
   7. Warranties.

1.2 CONTRACT

A. Contract Description: AIA Document A 121/CMc Standard Form of Agreement Between Owner and Construction Manager.

1.3 SCHEDULE OF VALUES

A. Submit schedule on AIA Form G703 or equivalent.

1.4 APPLICATIONS FOR PAYMENT

A. Submit five copies of each application on AIA Document G702 and G703.
B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
C. Payment Period: 30 days.

1.5 CHANGE PROCEDURES

A. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation.
B. Change Order Forms: AIA G701.

1.6 COORDINATION

A. Coordinate scheduling, submittals, and Work of the various sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements.
B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.
C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable.

D. In finished areas, conceal pipes, ducts, and wiring within the construction.

1.7 FIELD ENGINEERING

A. Employ a Land Surveyor to locate a reference datum and protect survey control and reference points.
B. Establish elevations, lines, and levels and certify that elevations and locations of the Work conform with the Contract Documents.
C. Provide a final as-built survey.

1.8 PRE-CONSTRUCTION MEETINGS

A. Architect will schedule a pre-construction meeting after Notice to Proceed for all affected parties.
B. When required in individual specification section, convene a pre-installation meeting at Project site prior to commencing work of the section.

1.9 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at weekly and/or bi-monthly intervals.
B. Preside at meetings, record minutes, and distribute copies within four days to those affected by decisions made.

1.10 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
B. Verify that utility services are available, of the correct characteristics, and in the correct location.

1.11 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.
B. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

1.12 CUTTING AND PATCHING

A. Employ a skilled and experienced installer to perform cutting and patching new Work; restore Work with new Products.
B. Submit written request in advance of cutting or altering structural or building enclosure elements.
C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
    1. Fit the several parts together, to integrate with other Work.
    2. Uncover Work to install or correct ill-timed Work.
    3. Remove and replace defective and non-conforming Work.
    4. Remove samples of installed Work for testing.
    5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
D. Cut masonry and concrete materials using masonry saw or core drill. Restore Work with new Products in accordance with requirements of Contract Documents.
E. Fit Work tight to adjacent elements. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
F. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
G. Refinish surfaces to match adjacent finishes.

1.13 SUBMITTAL PROCEDURES

A. Submittal form to identify Project, Contractor, Subcontractor or supplier; and pertinent Contract Document references.
B. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
C. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
D. Revise and resubmit submittals as required; identify all changes made since previous submittal.

1.14 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedule in duplicate within 15 days after date established in Notice to Proceed for Architect review.
B. Submit revised schedules as required, identifying changes since previous version. Indicate estimated percentage of completion for each item of Work at each submission.
C. Submit a horizontal bar chart with separate line for each major section of Work or operation, identifying first work day of each week.

1.15 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, submit list of major Products proposed for use, with name of manufacturer, trade name, and model number of each product.

1.16 SHOP DRAWINGS

A. Shop Drawings for Review:
    1. Submitted to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

B. Shop Drawings for Information:
    1. Submitted for the Architect's benefit as contract administrator or for the Owner.
    2. Reports of inappropriate or unacceptable work may be subject to action by the Architect or Owner.
C. Shop Drawings For Project Close-out:
    1. Submitted for the Owner's benefit during and after project completion.

1.17 PRODUCT DATA

A. Submit the number of copies which the Contractor requires, plus three copies which will be retained by the Architect.
B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this project.

1.18 SAMPLES

A. Submit samples to illustrate functional and aesthetic characteristics of the Product.
B. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Architect's selection.

1.19 MANUFACTURER INSTALLATION INSTRUCTIONS

A. When specified in individual specification sections, submit manufacturer printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.

1.20 MANUFACTURER CERTIFICATES

A. When specified in individual specification sections, submit certifications by manufacturer to Architect, in quantities specified for Product Data.
B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

1.21 QUALITY ASSURANCE - CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
B. Comply with manufacturers' instructions.
C. Comply with specified standards as minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

1.22 TOLERANCES

A. Monitor tolerance control of installed Products over suppliers, manufacturers, Products, site conditions, and workmanship, to produce acceptable Work. Do not permit tolerances to accumulate.
B. Comply fully with manufacturers' tolerances.

1.23 REFERENCES

A. Conform to reference standard by date of issue current as of date of Contract Documents.
B. Should specified reference standard conflict with Contract Documents, request clarification from Architect before proceeding.

1.24 SPECIAL INSPECTIONS & MATERIAL CERTIFICATIONS FOR STRUCTURAL SYSTEMS

A. The Owner shall employ and pay for the services of an independent firm to perform special inspections as required in the 2020 Building Code of New York State.
B. Service shall include but are not limited to geotechnical inspections, compaction test, concrete testing, and topsoil chemical composition test. Field Inspections of Welds, Bolted Connections and Periodic Wood Framing Inspections. The Owner and Architect shall receive copies of all test reports.
C. The Contractor/ CM will coordinate scheduling of all Special Inspections.
D. All deficient work will be corrected and re-tested.
E. Material Certification
   The Contractor shall submit Material Certifications for the following:
   1. Foundation Reinforcing Steel
   2. CMU Certification – ASTM C90, Grade N, Type I
   3. Mortar Certification – ASTM C270, Type S
   4. CMU Reinforcing Submittal
   5. Structural Steel Manufacturer's Certification
   6. Lumber Grade Certification
   7. Floor Truss Shop Drawings

1.25 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual specification sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions and to initiate instructions when necessary.
B. Report observations and site decisions or instructions that are supplemental or contrary to manufacturers' written instructions.

1.26 TEMPORARY ELECTRICITY

A. Cost: Contractor provide and pay for power service required from source. Provide power outlets for construction operations, branch wiring, distribution boxes, and flexible power cords as required.
B. The existing facility may not be utilized.

1.27 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain temporary lighting for construction operations.
B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
C. Permanent building lighting may be utilized during construction. Repair, clean, and replace lamps at end of construction.

1.28 TEMPORARY HEAT

A. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
B. Contractor to pay cost of energy used.
C. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
D. Maintain minimum ambient temperature of 55 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
E. Contractor to assure that the building shell be properly enclosed during temporary heat use.

1.29 TEMPORARY VENTILATION

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.30 TEMPORARY WATER SERVICE

A. Provide, maintain and pay for suitable quality water service required. Connect to existing water source for construction operations.
B. The existing facility may not be utilized.

1.31 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. New facilities may not be used.
B. Maintain in clean and sanitary condition.

1.32 BARRIERS AND FENCING

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage.
B. Construction: Contractor's option.

1.33 WATER CONTROL

A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
B. Provide erosion control.

1.34 EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closures to exterior openings to permit acceptable working conditions and protection of the Work.

1.35 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification sections.
B. Prohibit traffic or storage upon waterproofed or roofed surfaces.

1.36 SECURITY

A. Provide security and facilities to protect Work and Owner's operations from unauthorized entry, vandalism, or theft.

1.37 MAINTENANCE OF TRAFFIC

A. DESCRIPTION
   1. Maintain vehicular and pedestrian traffic to protect the public from damage to person and property within the limits of and for the duration of the contract work.
   2. Construct temporary pavements if required to maintain traffic.
   3. Erect and maintain barricades and signs.
   4. Provide competent flagmen.
   5. Provide lights and flashers where required.
   6. Control dust, dirt and other accumulations on roads.
   7. Observe local traffic regulation and avoid use of the parking on West Burda Road. Alternate parking areas will be available.

B. REFERENCED STANDARDS, REQUIREMENTS
   1. Comply with applicable provisions of New York State Department of Transportation Standard Specifications, January 2, 1985 (NYSDOT), Section 619 - Maintenance and Protection of Traffic.
   2. Comply with New York State Department of Transportation Manual of Uniform Traffic Control Devices.

1.38 PROGRESS CLEANING AND WASTE REMOVAL

A. Collect and maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

1.39 FIELD OFFICES AND SHEDS

A. Office: Weather tight, with lighting, electrical outlets, heating and air conditioning and equipped with sturdy furniture and drawing display table.
B. Provide space for Project meetings, with table and chairs to accommodate 12 persons.

1.40 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

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

1.41 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work.
B. Provide interchangeable components of the same manufacture for components being replaced.

1.42 TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

A. Transport, handle, store, and protect Products in accordance with manufacturer's instructions.

1.43 PRODUCT OPTIONS

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

1.44 SUBSTITUTIONS

A. Architect will consider requests for Substitutions only within 15 days after date established in Notice to Proceed.
B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
C. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.

1.45 STARTING SYSTEMS

A. Provide seven days notification prior to start-up of each item.
B. Ensure that each piece of equipment or system is ready for operation.
C. Execute start-up under supervision of responsible persons in accordance with manufacturers' instructions.
D. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.46 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.
B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at designated location.

1.47 TESTING, ADJUSTING, AND BALANCING

A. Contractor will appoint and employ services of an independent firm to perform testing, adjusting, and balancing. This does not include "special inspection services" as noted previously.
B. Reports will be submitted by the independent firm to the Architect indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with the requirements of the Contract Documents.
C. Cooperate with independent firm; furnish assistance as requested.
D. Re-testing required because of non-conformance to specified requirements will be charged to the Contractor.

1.48 CONTRACT CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect's inspection. Contractor to correct deficiencies to satisfy requirements of contract document and NYS Department of Health.
B. Submit final Application for Payment identifying total adjusted Contract Sum/Price, previous payments, and amount remaining due.

1.49 FINAL CLEANING

A. Execute final cleaning (move-in quality) prior to final inspection.
B. Clean interior and exterior surfaces exposed to view. Vacuum carpeted and soft surfaces.
C. Clean debris from site, roofs gutters, downspouts, and drainage systems.
D. Clean filters of operating equipment.
E. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.50 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.51 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of Contract Documents to be utilized for record documents.
B. Record actual revisions to the Work. Record information concurrent with construction progress.
C. Specifications: Legibly mark and record at each Product section a description of actual Products installed.
D. Record Documents and Shop Drawings: Legibly mark each item to record actual construction.
E. Final As-Built Drawings
    1. Final submission of as-built drawings shall be submitted either printed on Mylar Sheets, or on bond paper suitable for permanent storage plus three copies of the documents on flash drive submitted in Adobe PDF format. A preliminary submission of the final drawings printed on bond paper may be submitted for review before producing the final as-built set. Drawing files submitted must comply with the following:
        a. Include a generic text file that explains the contents of the disk and the format of the drawing files.
        b. Saved in folders and with file names that correlate to the printed documents.
        c. Saved in a format that matches the final version of the printed drawings. Provide only information relevant to each drawings and do not include extraneous information and details which are not included in the final documents.
        d. Include the Certificates(s) of Occupancy in a separate file.
    2. Label all drawing sheets with an as-built title and final date. Any sheets with no changes are to have a statement added that no changes have been made from the original drawing sheet.
    3. Drawings shall consist of a reproduction of the complete contract drawings updated to reflect changes made during the construction of the project and with added information, as necessary, to explain aspects of the project in further detail than in the contract set.
        a. Add details to the contract set of drawings issued during construction by the project architect for change orders and supplementary instructions.
        b. Add sheets which include shop drawings, manufacture data, or details from product submissions issued during construction which explains this information in better

detail. (Boilers, schematics of controls, & piping are good examples of this).

c. Update the drawing index to denote changes made by adding or deleting drawings from the original contract drawings.

4. Ensure that special attention is given to explain locations, with dimensions, of buried utilities & structures, utility valves & shut-offs, electrical controls, and other maintenance devices.
5. Drawings shall be submitted with a cover memo from the project architect stating that he/she has reviewed the set and is satisfied that the set is complete and that included information is well coordinated without inaccuracies or confusing duplications.

E. Warranties must comply with the following:

6. All components and building systems to have a minimum of one year materials and labor warranty.
7. All warranties and guarantees listed in the project specifications that have a warranty period greater than one year must be submitted at the project close out. The following items, although not entirely inclusive, must be submitted: roof; doors; door hardware and accessories; windows; flooring; specialties; mechanical system; electrical systems; and plumbing.
8. Include a copy of each warranty, properly labeled by warranty section, in a separate warranty folder on the flash drive.

F. Other Submissions:

In addition to the above, provide copies of the following prior to project closeout at construction completion:

1. Final Certificate(s) of Occupancy
2. Project Architect's Certificate of Substantial Completion (AIA G704)
3. Contractor's final application for payment (AIA G703/703) certified by project Architect
4. Project Architect's Certification in accordance with Appendix C
5. Contractor's Affidavit of Release of Liens (AIA G706A)
6. Contractor's Affidavit Payment of Debts and Claims (AIA G706)
7. Final summary report by the energy consultant
8. Certification from the energy efficiency program, if applicable
9. Final summary report by the green building consultant, if applicable
10. Certification from the green building program, if applicable

G. Building Systems

Contractor to record and provide videos of training sessions for HVAC and other building systems for the use of building maintenance staff.

END OF SECTION

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 OVERVIEW

A. This section of the specification describes the process for commissioning and defines the responsibilities of the commissioning agent, the contractors, and outlines the duties of other members of the commissioning team.

B. The commissioning process shall be applied to all equipment, components, and systems as listed in this section, including specific interfaces to and from equipment and systems provided under separate contracts.

C. Building Commissioning work is a joint team effort to ensure that all systems function together properly to meet the design intent, and to document system performance parameters for fine-tuning of control sequences and operations procedures. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment start-up, control system calibration, testing and balancing, training, and performance testing. This section does not supersede other requirements of the specifications. It may, though, expand on some of them.

1.2 COMMISSIONING AGENT

A. The Commissioning Agent (CA) will be an independent 3rd party engaged by the General Contractor.

1.3 STANDARD AND CODE COMPLIANCE

A. Commissioning will be accomplished to comply with, and in accordance with the requirements of the following:

1. 2020 Energy Conservation Construction Code of New York State, Section C408 System Commissioning.

1.4 THE COMMISSIONING TEAM

A. The commissioning team shall consist of:

1. Commissioning Agent (CA).
2. HVAC Contractor (HC).
3. Plumbing Contractor (PC).
4. Electrical Contractor (EC).
5. General Contractor (GC).
6. Fire Protection Contractor (FPC).

7. All appropriate Contractors and Sub-Contractors including but not limited to; temperature controls, sheet metal, testing and balancing, fire alarm fire protection and elevator installer.

8. Approved Representatives of Mechanical, Electrical and Equipment Manufacturers.

9. Design Engineers (DE).

10. Design Architect (ARCH).

11. Facility Staff (FS).

12. Owner's Representative (OR).

1.5 COORDINATION

A. Project Commissioning Team - The members of the Project Commissioning Team shall consist of the Commissioning Authority and any support personnel, the Owner's facility staff (FS) or designee, the HVAC Contractor, Electrical Contractor, Plumbing Contractor, Fire Alarm Contractor, Fire Protection Contractor, General Contractor, Elevator Vendor, or additional vendors as required, the Architect/Engineer (A/E) and Owner's Representative (OR).

B. Management - The CA coordinates the commissioning activities through the Owner's Representative (OR). All members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents. Refer to Paragraph 1.6 for additional management details.

C. Scheduling - The CA, through the OR, will provide sufficient notice to the Contractors for scheduling commissioning activities with respect to the Owner's participation. The Contractors will integrate all commissioning activities into the overall project schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1.6 COMMISSIONING PLAN

A. The CA will develop the Commissioning Plan which shall be included in the project schedule when approved by the Owner.

B. The Commissioning Plan shall contain the information necessary to document the commissioning process as it progresses from pre-start checks, to start-up and initial operation, and finally to functional performance verification of all systems.

C. The Commissioning Plan shall also contain a schedule of commissioning work, integrated with the overall project schedule. This schedule shall show:

1. Completion dates for each system or systems in each area of the building.

2. Dates for controls installation completion and point checkout.

3. Dates for carrying out Steps 1 and 2 commissioning work for each system or group of systems.

4. Submission dates for the documentation required by the Engineer prior to Step 3 verification.

5. Dates for carrying out Step 3 commissioning work.

D. The following narrative provides a brief overview of the commissioning tasks that shall be performed during construction and the general order in which they occur.

1. Commissioning during construction begins with an initial commissioning meeting conducted by the CA where the commissioning process is reviewed with the project commissioning team members.

2. Additional meetings will be required throughout construction, scheduled by the CA, through the Owner or OR, with necessary parties attending to plan, scope, coordinate, schedule future activities and address issues.

3. Equipment documentation is submitted to the CA, through the Owner, OR, Architect, during normal submittals, including detailed startup procedures.

4. The prefunctional checklists, developed by the CA are to be completed by the Contractor (or its Subcontractors), before and during the startup process.

5. Prefunctional checklists, TAB and startup must be completed before performance testing.

6. Items of non-compliance in material, installation, or setup shall be corrected at no expense to the Owner.

7. The Contractor ensures that the Subcontractors' prefunctional checklists are executed and documented and that startup and initial checkout are performed. The CA verifies that the TAB, prefunctional checklists and startup were completed according to the approved plans. This includes the CA approving TAB, checklists and startup plans. This also includes witnessing startup of selected equipment. Any testing failure is to be corrected at no additional cost to the Owner, and a re-test is to be performed, observed, and documented.

8. The CA develops and implements equipment and system functional test procedures. The forms and procedures are approved by the Owner and A/E.

9. The performance tests are executed by the Contractor under the direction of the CA with the assistance of the facility staff. All documentation is by the CA.

10. The CA provides the Commissioning Record.

11. Commissioning is to be completed before substantial completion.

12. Deferred testing and/or seasonal verifications are to be conducted as specified or required.

1.7 COMMISSIONING RESPONSIBILITIES

A. Commissioning Agent:

1. Plan, organize, direct and implement the Commissioning Process as specified herein.

2. Prepare the Commissioning Plan and submit for review by the Owner and Architect.

3. Revise the Commissioning Plan as required during construction.

4. Chair commissioning meetings, prepare and distribute schedules and agendas for the meetings, and prepare and distribute minutes to all Commissioning Team members, whether or not they attended the meeting.

5. Write the prefunctional checklists, initial operation and functional test procedures and submit for review by the Owner. The test procedures and checklists should be designed to verify detailed aspects of the proper operation of all equipment items and overall system performance in accordance with the design intent of the systems.

6. Coordinate commissioning activities among all Contractors, sub-trades, and suppliers, and all related commissioning requirements in the various specifications for all contracts.

7. Carry out all required system readiness checks and document the results as the checks are done.

8. In cooperation with the Controls Subcontractor, ensure all control point checkouts are carried out and the results documented as the checks are done.

9. Observe or verify all start-ups and initial system operations tests and checks, which shall encompass all specified functional performance tests, ensuring the results are documented as the tests and checks are done.

10. Provide periodic site visits as required to observe system installation.

11. Maintain master issues log. Resolution to issues found shall be documented by installing contractor and submitted to CA.

12. At the direction of the Engineer, ensure equipment and systems are operated for functional performance verification purposes.

13. Ensure all required training and demonstrations are provided to the Owner's designated operating staff and that all Operations and Maintenance manuals are submitted, approved and provided to the Owner.

14. Develop a Final Commissioning Record.

15. Coordinate deferred/seasonal commissioning required.

B. Contractors:

1. Within four (4) weeks of the award of the contract, the HC, PC, GC, EC, FPC Contractors and relevant subcontractors shall submit the names of the Project Manager who will be the Commissioning Coordinator for this project, as well as the names, addresses, phone numbers and qualifications of Subcontractors' Representatives and factory trained Manufacturer's Representatives for all equipment and systems required to participate in the Commissioning Process as specified in this Section.

2. Each Contractor and all his sub-trades and suppliers, shall cooperate with the Commissioning Agent in carrying out the Commissioning Process. In this context, each Contractor shall:

a. Provide equipment and systems start-up as specified.

b. Operate equipment and systems as required for initial systems operations, and witness final functional performance tests as they are performed by the Commissioning Agent, including the on-site participation of approved factory trained Manufacturer's Representatives for equipment.

c. Attend commissioning meetings and attend to action items arising from them, as required to allow the Commissioning Process to proceed on schedule.

d. Provide instruction and demonstrations for the Owner's designated operating staff, in conjunction with the Commissioning Agent, in order to meet all specified training requirements in this regard.

e. The Contractors shall make any and all necessary corrections to systems, equipment, O & M manuals, as built drawings, and procedures as necessary to meet the design intent, contract documents, manufacturer's recommendations or performance requirements if errors are discovered during the Commissioning Process.

f. The Contractors shall supply all necessary documentation, such as shop drawings, submittal data, maintenance manuals, etc. required for equipment and systems, to the Commissioning Agent for preparation of the commissioning plan, checklists, and functional performance plans.

g. The Contractors shall provide the required names, addresses and qualifications of all specified Manufacturer's Representatives to participate in the Commissioning Process prior to the initial commissioning meeting.

h. Subsequent installation and performance verifications, made necessary due to required corrections after initial verification, shall be at the respective Contractor's expense.

i. Carry all commissioning related costs in contract bid price.

j. Review all documentation provided by CA and provide comments, if required prior to on site commissioning activities.

k. Engage, at Contractor's cost, any Manufacturer's Representatives required to complete start-up and commissioning activities.

l. Include cost of all devices and special tools to complete commissioning activities.

C. Manufacturer's Representatives:

1. The factory trained and authorized Manufacturer's Representatives shall participate in the commissioning process as specified in this section and as indicated in the technical section of the specifications.

2. Each Manufacturer's Representative shall cooperate with the commissioning agent in carrying out the commissioning process. In this context, each Manufacturer's Representative shall:

a. Provide equipment start-up as specified.

b. On-site participation as required for initial equipment operations and witness final functional performance tests as they are performed by the commissioning agent.

c. Attend commissioning meetings, as applicable and attend to action items arising from them, as required to allow the commissioning process to proceed on schedule.

d. Provide instruction and demonstrations for the Owner's designated operating staff, as specified in conjunction with the commissioning agent, in order to meet all specified training requirements in this regard.

e. Make any and all necessary corrections to equipment, O&M manuals, as-built drawings and procedures as necessary to meet the design intent, contract documents or performance requirements if errors are discovered during the commissioning process.

f. Subsequent installation and performance verifications, made necessary due to required corrections after initial verification, shall be at the respective manufacturer's expense.

D. Design Engineers and Architects:

1. Provide "Basis of Design" documentation inclusive of design criteria for CA review.

2. The Design Engineers and Architect shall review the Commissioning Plan, commissioning checklists and functional performance test plans. They shall also participate, as appropriate, in on-site commissioning meetings.

3. During the functional performance phase of the Commissioning Process, the Design Engineers and Architects may be on site to review commissioning documentation, witness functional performance tests, and verify acceptable performance or to declare performance unacceptable, as required.

4. Provide design narrative information to CA as required.

5. Participate in deficiency resolution process of items identified during Commissioning Process.

E. Owner's Representative (User):

1. Provide "Owner's Project Requirements" documentation for CA review.

2. The Owner shall ensure the availability of operating staff for all scheduled training and demonstration sessions. This staff shall possess sufficient skills and knowledge to operate and maintain the installation following attendance at these sessions.

3. Attend commissioning meetings.

4. Sign off of all accepted functional test procedures.

5. Participate in seasonal/deferred testing.

1.8 DESCRIPTION OF WORK

A. The "Systems and Equipment" as referred to in this section of the specifications shall include, but not be limited to, subsystems and components of subsystems; as provided by various contracts as follows:

1. HVAC Systems
2. Domestic Hot Water Equipment
3. Daylight/Dimming Controls
4. Lighting System, Scheduled Lighting Controls and Occupancy Sensors
5. Fire Protection Systems
6. Fire Alarm Systems
7. Plumbing Fixtures and Controls
8. Elevator Controls

1.9 COMMISSIONING PROCESS

A. The on-site commissioning process shall be organized and carried out in four (4) steps as follows:

1. Step 1 - System readiness and start-up.
2. Step 2 - Initial operation.
3. Step 3 - Functional performance verification.
4. Step 4 - Demonstration and instruction.

B. Each step is applicable to each separate system and its components, as listed in Part 3, including all related controls and specified interfaces to other divisions and contracts.

C. The Contractors shall review and verify the commissioning schedule and requirements for the interface between all trades in order to prevent delays in the Commissioning Process.

D. In some systems, improper adjustments, misapplied equipment, and/or deficient performance under varying loads may result in additional work being required to commission the systems. This work shall be completed under the direction of the General Contractor with input from the Contractors, Equipment Supplier, and Commissioning Agent. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Design Architect or Engineer shall have final jurisdiction over any additional work done to achieve performance.

E. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Experimentation to demonstrate system performance may be permitted. If the Commissioning Agent deems the experimentation work to be ineffective or untimely as it relates to the Commissioning Process, the Commissioning Agent shall notify the Owner, indicating the nature of the problem, expected steps to be taken, and suggestions for completion of activities. Costs incurred to solve the problems in an expeditious manner shall be the Contractor's responsibility.

F. Seasonal commissioning is required under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Simulations of peak load conditions may be implemented to allow for complete commissioning of the work.

G. Systems that are not weather dependent shall be tested under full and partial load to the fullest extent possible.

1.10 STEP 1 - SYSTEMS READINESS AND START-UP

A. Before starting any equipment or systems, the Contractors shall complete the system readiness or pre-start checks in the commissioning plan and the Commissioning Agent shall document the results. The following conditions and items shall be completed as applicable:

1. Piping systems have been pressure tested as specified, found to be tight, with reports submitted.

2. Piping systems have been flushed and cleaned as specified, any required reports submitted, and then filled or charged as applicable.

3. Equipment has been lubricated to specification.

4. Air system cleaning is complete, and particulate filters have been installed.

5. Vibration isolation has been installed to specification and adjusted.

6. Equipment drives have been aligned.

7. Electrical, water and fuel services have been installed and checked.

8. Control point checkouts have been completed.

9. Safety controls have been installed and operation checked.

10. Major equipment start-up has been carried out by Manufacturer's Representative when specified and required startup reports completed and submitted.

B. All checks shall be documented on the relevant checklists as they are carried out. Deficiencies or incomplete work shall be corrected and the checks repeated until the installation is ready for operation before proceeding to Step 2 of the process.

1.11 STEP 2 - INITIAL OPERATION

A. In Step 2 of the Commissioning Process, the Contractors, with the Commissioning Agent verifying, complete the testing, balancing, and calibration of all components and systems. They also operate all systems through all specified modes of operation and test system responses to specified abnormal or emergency conditions.

B. Work carried out during this step of commissioning shall include but not be limited to, the following:

1. Air systems balancing, including positioning of all balance dampers, adjustments to diffusers, registers and grilles.

2. Hydronic systems balancing, including positioning of all balance valves.

3. Correction of problems revealed during balancing, including changes to fan speeds or blade pitch as necessary.

4. Setting up and calibrating all automatic temperature controls devices, including adjustments to control valves and damper actuators.

5. Setting up or programming controls for accurate response and precise sequencing to meet specified performance.

6. With Commissioning Agent verifying, the Balancing Contractor and Controls Contractor working together setting up airflows and controls calibrations for terminal units and airflow stations.

7. Ensuring final adjustments to vibration isolation are carried out as necessary.

C. As was done in Step 1, all checks and tests shall be documented on the relevant checklists as they are carried out. Deficiencies or incomplete work shall be corrected, and the checks or tests repeated until correct installation and function has been confirmed and the installation is ready for engineering verification.

1.12 STEP 3 - FUNCTIONAL PERFORMANCE TEST AND VERIFICATION

A. All equipment and systems shall be operated through the entire specified sequence of operations for witness and verifying acceptable operation, by the Commissioning Agent.

B. During this step of commissioning, the following checks and test shall be required:

1. Check the location and accessibility of all access panels.

2. Operation of all control system devices, both sensors and actuators.

3. Proper physical response of all controlled devices and components to setpoint changes or other relevant adjustments.

4. Operation of randomly selected motorized dampers.

5. Demonstration of acceptable noise and vibration levels from major equipment, under its full range of operational conditions.

6. Operation of equipment and systems under every specified mode of operation and sequence of control.

7. Once acceptable performance of systems has been verified, then verification of specified interfaces to/from equipment and systems provided under other divisions and contracts shall be performed.

1.13 STEP 4 - DEMONSTRATION AND INSTRUCTION

A. The formal demonstration and instruction for operating staff shall commence once the Step 3 commissioning is complete and substantial completion achieved.

B. Demonstration and instruction in accordance with the "Design Intent" shall cover all equipment and systems and their controls.

1.14 COMMISSIONING START-UP AND COMPLETION

A. Commissioning of certain systems may be required to be performed during both heating and cooling seasons. Commissioning shall be performed at the earliest such time as possible after substantial completion of each system.

1.15 REFERENCES

A. Systems commissioning shall be accomplished as specified and in accordance with the latest version of commissioning publications from one the following industry associations:

1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Guideline 1.1, HVAC&R Technical Requirements for the Commissioning Process.

2. Associated Air Balancing Council, Commissioning Reference Manual.

3. Building Commissioning Association - The Building Commissioning Handbook.

1.16 DOCUMENTATION

A. Each Contractor shall provide to the Commissioning Agent three (3) copies of the following items as soon as they become available:

1. Certified and approved start-up and testing report forms for all subsystem equipment that comprise the System. Commissioning documentation shall include control schematics of the total system and all subsystems.

2. Records of required inspections for code compliance, and documentation of approved permits and licenses to operate components of the System.

3. Operating data which shall include all necessary instructions to the Owner's operating staff in order to operate the system to specified performance standards.

4. Maintenance data which shall include all necessary information required to maintain all equipment in continuous operating condition, such as the testing, balancing and adjusting report and the as-built drawings.

5. Written notice that building equipment and systems have been completed, tested and are fully operational.

6. Checklist of all submitted contract deliverables such as; operation and maintenance manuals, spare parts, warranties, training, documentation, etc.

PART 2 - PRODUCTS

2.1 TESTING

A. The Contractor shall provide any equipment or device required for access such as platforms, scaffolds, and spare filters as may be necessary for all verification and testing.

B. All standard testing equipment required to perform startup and initial checkout and required performance testing shall be provided by the Contractor for the equipment being tested. This includes, but is not limited to, two-way radios, meters, and data recorders.

C. Special equipment, tools, and instruments required for testing equipment according to these contract documents shall be included in the Contractor's base bid price and shall be turned over to the Owner at project close-out.

D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration to NIST traceable standards within the past year to an accuracy of 0.5°F and a resolution of ± 0.1°F. Pressure sensors shall have an accuracy of ± 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 GENERAL

A. Each Contractor shall coordinate with the Commissioning Team in the construction phase of the project to assure compliance with all system commissioning requirements.

3.2 DESIGN CRITERIA AND INTENT

A. Design criteria and intent shall be as described in the technical specification sections and contract drawings. The basis of design developed by the Architect and Engineer will be also referenced.

3.3 MEETINGS

A. Initial Meeting:

1. The CA, through the OR, will schedule, plan and conduct an initial commissioning meeting. The Contractors and their responsible parties are required to attend.

B. Miscellaneous Meetings:

1. Other meetings will be planned and conducted by the CA as construction progresses. These meetings will cover coordination, deficiency resolution, and planning issues. These meetings will be held to the extent possible following construction meetings to minimize additional travel for all parties.

3.4 STARTUP, CONSTRUCTION CHECKLISTS AND INITIAL CHECKOUT

A. The following procedures apply to all equipment/systems to be commissioned.

B. General: Prefunctional checklists are required to verify that the equipment and systems are fully connected and operational. It ensures that performance testing (in-depth system checkout) may proceed without unnecessary delays. The prefunctional checklists for a

given system must be successfully completed and approved prior to startup and formal performance testing of equipment or subsystems of the given system.

C. Startup and Checkout Plan: The CA will assist the Project Commissioning Team members responsible for startup of any equipment. The primary role of the CA in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures has been completed. The CA shall provide prefunctional checklists and startup shall be identified in the commissioning scoping meeting and on the checklist forms.

1. The prefunctional checklists will be developed by the CA and provided to the Contractors. These checklists indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.

2. The Contractor shall determine which trade is responsible for executing and documenting each of the line item tasks and transmit the checklists to the responsible subcontractors. Each form may have more than one trade responsible for its execution.

3. The Contractor/Subcontractor responsible for the purchase of the equipment shall develop the full startup plan by combining the manufacturer's detailed startup and checkout procedures and the prefunctional checklists.

4. The Contractor/Subcontractor shall submit the full startup plan to the CA for review and approval.

5. The CA will review and approve the procedures and the documentation format for reporting. The CA will return the procedures and the documentation format to the Contractor.

6. The Contractor will transmit the full startup plan to the Subcontractors for their review and use.

D. Sensor and Actuator Calibration: All field-installed temperature, relative humidity, CO, CO_2, refrigerant, O_2, and/or pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated. Verify that all locations are appropriate and away from causes of erratic operation. Submit to the CA the calibration methods and results. All test instruments shall have had a certified calibration within the last six (6) months to NIST traceable standards, and comply with all local, state and/or federal requirements/certifications, as required. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated. Provide bench testing as required at the direction of the CA.

1. Sensor Calibration Methods:

a. All Sensors - Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable, are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are

reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.

b. Sensors without Transmitters - Standard Application. Make a reading with a calibrated test instrument within 6 in. of the site sensor. Verify that the sensor reading (via the permanent thermostat, gauge or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.

c. Sensors with Transmitters - Standard Application. Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 in. of the site sensor. Verify that the sensor reading (via the permanent thermostat, gauge or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.

Tolerances, Standard Applications

Sensor	Required Tolerance (+/-)		Sensor	Required Tolerance (+/-)
Outside air, space air, duct air temps	0.4F		Flow rates, air	10% of design
Watthour, voltage & amperage	1% of design		Flow rates, water Relative humidity Oxygen or CO_2 monitor CO monitor	4% of design 4% of design 0.1% pts 0.01 % pts
Pressures, air, water and gas	3% of design		Barometric pressure	0.1 in. of Hg

d. Valve and Damper Stroke Setup and Check EMS Readout: For all valve and damper actuator positions checked, verify the actual position against the BAS readout. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

E. Execution of Construction Checklists and Startup:

1. Two (2) weeks prior to the scheduled start up, the Contractor shall coordinate startup and checkout with the Owner, A/E, OR, and CA. The execution and approval of the construction checklists, startup, and checkout shall be directed and performed by the Contractor, Subcontractor or Vendor. Signatures are required of the applicable Subcontractors for verification of completion of their work.

2. The Owner and facility personnel as necessary, shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, in which case a sampling strategy may be used.

3. For lower-level components of equipment, (e.g., sensors, controllers), the CA shall observe a sampling of the startup procedures.

4. The Contractors, Subcontractors and Vendors shall execute startup and provide the CA with a signed and dated copy of the completed startup and construction checklists.

5. Only individuals employed by the Contractor (Technicians, Engineers, Tradesmen, Vendors, etc.) who have direct knowledge and witnessed that a line item task on the construction checklist was actually performed shall check off that item. It is not acceptable for non-witnessing onsite supervisors to fill out these forms.

F. Deficiencies, Non-Conformance, and Approval of Checklists and Startup (Master Issues Log):

1. The Contractor shall ensure that the Subcontractors clearly list any outstanding items of the initial startup and construction checklist procedures that were not completed successfully, on an attached sheet. The form and any outstanding deficiencies shall be provided, to the CA within two (2) days of test completion.

2. The CA will review the report and issue either a non-compliance report or an approval form, to the Contractor. The installing Contractors or Vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, shall notify the CA as soon as outstanding items have been corrected, and resubmit an updated startup report with a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CA will recommend approval of the execution of the checklists and startup of each system.

3. Items left incomplete, which later cause deficiencies or delays during performance may result in backcharges to the Contractor.

3.5 FUNCTIONAL PERFORMANCE TESTING

A. Requirements: The functional performance testing shall demonstrate that each system is operating according to the documented design intent and contract documents. Functional

performance testing facilitates bringing the systems from a state of individual substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

B. Coordination and Scheduling: The Contractor shall provide sufficient notice, regarding their completion schedule for the construction checklists and startup of all equipment and systems to allow the performance testing to be scheduled. The CA shall oversee, witness, and document the performance all equipment and systems. The CA, in association with the Contractor/Subcontractors and Facility Staff, shall execute the tests. Performance testing shall be conducted after the construction checklists, and startup has been satisfactorily completed. The control system shall be sufficiently tested and approved by the CA before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed and approved before performance testing of air or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems shall be checked.

C. Development of Test Procedures: Before test procedures are finalized, the Contractor shall provide to the A/E and the CA all requested documentation and a current list of changes affecting equipment or systems, including an updated points list, program code, control sequences, testing parameters, supplemental instructions, and addenda. Using the testing parameters and requirements in the technical specifications, the CA shall update/develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Contractor/Subcontractor or vendor, as appropriate, shall provide assistance to the CA in developing the final procedures. Prior to finalization, the A/E shall review and concur with the test procedure.

D. Test Methods:

1. Performance testing and verification may be achieved by manual testing or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The CA may substitute specified methods or require an additional method to be executed other than what was specified, with the approval of the A/E. The CA will determine which method is most appropriate for tests that do not have a specified method.

2. Simulated Conditions. Simulating conditions shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.

3. Overridden Values. Overriding sensor values to simulate a condition, such as overriding the outside air temperature reading in a control system to be something other than ambient is acceptable.

4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overridden values.

5. Altering Sensors. Overriding sensor values and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable.

6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the test parameters, that the indirect readings through the control system represent actual conditions and responses.

7. Setup. Each functional performance test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor/Subcontractor(s) assisting the CA in executing the test shall provide all necessary materials, system modifications, etc., to produce the necessary flows, pressures, temperatures, etc., necessary to execute the test according to the specified conditions. At completion of the test, the Contractor/ Subcontractor(s) shall return all affected equipment and systems to their approved operating settings.

E. Problem Solving: The burden of responsibility to solve, correct, and retest malfunctions/failures is with the Contractor, with the CA providing suggestions.

3.6 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS

A. Documentation: The CA shall witness and verify/pre-approve the documentation of the results of all performance tests. The CA shall complete all documentation for performance testing.

B. Non-Conformance:

1. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. In such cases the deficiency and resolution will be documented on the procedure form or on an attached sheet. If the correction is made immediately, the item does not need to be added to the issues log.

2. As tests progress and a deficiency is identified, the CA shall discuss the issue with the Commissioning Team and the Contractor.

a. When there is no dispute regarding the deficiency and the Contractor accepts responsibility to correct it:

1) The CA will document the deficiency and the Contractor's response and intentions. After the day's work, the CA will enter the item into the issues log. The Contractor corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CA.

2) The Contractor shall reschedule the test; and the test is repeated. The issues log is amended by the CA.

b. If there is a dispute about a deficiency, regarding whether or not it is a deficiency:

1) The dispute shall be documented on the non-compliance form with the Contractor's response.

2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E.

3) The CA documents the resolution process in the issues log.

4) Once the interpretation and resolution have been decided, the contractor corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CA. The contractor shall reschedule the test and the test is repeated until satisfactory performance is achieved.

3. Cost for the CA to retest a functional performance test is borne by Contractor's.

4. The Contractor shall submit in writing to the CA at least as often as commissioning meetings are being scheduled, the status of each outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreement and proposed resolutions.

a. The CA retains the original non-conformance forms until the end of the project.

b. Retesting shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

C. Failure Due to Manufacturer Defect: If 10% (or three (3), whichever is greater) of identical pieces of equipment fail to perform to the contract documents (mechanically or substantively) due to a manufacturing defect, not allowing it to meet its submitted performance specification, all identical units may be considered unacceptable. In such case, the Contractor shall provide the Owner with the following:

1. Within one (1) week of notification from the Owner, 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 CA within two (2) weeks of the original notice.

2. Within two (2) 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. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The A/E will determine whether a replacement of all identical units or a repair is acceptable.

4. Two (2) examples, where applicable, of the proposed solution shall be installed by the Contractor and the A/E shall be allowed to test the installations for up to one (1) week, upon which the A/E 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. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts or material can be obtained.

D. Approval: The CA notes each satisfactorily demonstrated function on the test form. Final acceptance of the functional performance test by the Owner is made after review by the CA, following recommendations by the A/E.

3.7 DEFERRED TESTING

A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the project completion level, weather conditions, or time of season, execution of checklists and functional performance testing may be delayed upon approval of the CA. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Contractors will not be due any additional compensation.

B. Seasonal Testing: During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CA shall coordinate this activity through the Owner. Tests will be executed, documented by the CA and deficiencies should be corrected by the appropriate Contractor/Subcontractors with the CA witnessing. Any final adjustments to the O&M manuals and as-built's due to the testing shall be made by the Contractor.

3.8 COMMISSIONING RECORD

A. The CA is responsible to compile, organize and index the following commissioning data, for all commissioned equipment into labeled, indexed and tabbed, three-ring binders and deliver it to the Owner.

1. Commissioning Plan.

2. System reports including available design narratives and criteria including sequences. Each system shall contain the startup plan and report, approvals, corrections, construction checklists, completed performance tests, trending and analysis, training plan and recommended recommissioning schedule.

3. Complete issues log inclusive of all items and resolutions.

4. Final Commissioning Report including an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the Commissioning Authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:

a. Equipment meeting the equipment specifications.

b. Equipment installation.

c. Performance and efficiency.

d. Equipment documentation and design intent.

e. Operator training.

5. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific performance test, inspection, trend log, etc. where the deficiency is documented. The performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

3.9 PRE-WARRANTY REVIEW

A. CA will conduct a pre-warranty review of the project approximately ten (10) months following final completion of the project. CA will provide to the Owner a list of remedial items that are required to be addressed by Contractors prior to warranty expiration. Contractors, at their cost, will address all identified items in their respective trades within thirty (30) day of notification. Upon completion of work, Contractor will notify Owner, Commissioning Authority, and Design Architect/Engineer in writing.

END OF SECTION

SECTION 030000

CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork, reinforcement, accessories, cast-in-place concrete, finishing and curing.

1.2 QUALITY ASSURANCE

A. Construct and erect concrete formwork in accordance with ACI 301 and 347, unless specified otherwise in this Section.

B. Perform concrete reinforcing work in accordance with ACI 301 and CRSI 63, 65 and Manual of Standard Practice, unless specified otherwise in this Section.

C. Perform cast-in-place concrete work in accordance with ACI 301, unless specified otherwise in this Section.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Plywood: PS 1, C Grade Douglas Fir species; structural grade; sound, undamaged sheets with clean true edges.

B. Lumber: Douglas Fir species; structural grade.

C. Prefabricated Steel Type: Matched, tight fitting, stiffened to support weight of concrete.

D. Pan Type: Steel; of size and profile required.

E. Form Ties: Removable or Snap-off metal type of adjustable length, cone type.

F. Waterstops: Purpose made rubber, 1 inch wide, maximum possible lengths, profiled as required; manufactured by Volclay or equal.

G. Form Release Agent: Colorless mineral oil which will not stain concrete or impair natural bonding characteristics of coating intended for use on concrete.

H. Formed Construction Joints for Slab-on-Grade: Galvanized steel, tongue and groove type profile, knockout holes to receive dowelling.

I. Slab Edge Joint Filler: ASTM D1751, premolded asphaltic board, 1/2 inch thick.

J. Vapor Barrier: Stego Wrap 15 mil Class A or equal

K. Void Forms: Moisture resistant treated paper faces; biodegradable; structurally sufficient to

support weight of wet concrete mix until initial set; 2 inches thick.

2.2 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; plain billet steel bars, plain finish.

B. Welded Steel Wire Fabric: ASTM A185, plain type, in flat sheets, plain finish.

C. Fibermesh: ASTMC1116/C equal to fibermesh 150-e3

D. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for support of reinforcing.

E. Fabricate concrete reinforcing in accordance with ACI 315.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C150, Normal-Type I Portland type.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Clean and not detrimental to concrete.

D. Air Entrainment Admixture: ASTM C260.

E. Bonding Agent: Polymer resin emulsion.

F. Non-shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticising agents.

2.4 COMPOUNDS, HARDENERS AND SEALERS

A. Chemical Hardener: Lapido-Lith manufactured by Sonneborn.

B. Sealer: (Exposed Floors Only) Pitt-Loc manufactured by Sonneborn.

2.5 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94, Alternative 2.

B. Provide concrete of the following strength at 28 days:
1. Compressive Strength: 3000 psi, except for exterior horizontal concrete which shall be 4,000 psi.
2. Slump: 3 to 4 inches.

C. Select admixture proportions for normal weight concrete in accordance with ACI 301 Method 1.

D. Design Mix
1. FORMULA NAME: 3000# W/2S DESCRIPTION: #2 Stone Max
Slump 5" 5-7% Air

INGREDIENTS	AMOUNTS

CEMENT	488 lbs.
#2 STONE	885 lbs.
#1 STONE	1015 lbs.
FINE	1368 lbs.
COLD WATER	29 gals.
DARVAIR (air entrainment)	.500/100 lbs. cement
HYCOL (plasticizer, water reducer)	0.50 oz./100 lbs. cement
EXCELORATOR	.00 oz./100 lbs. cement
DARATARD (retarder water reducer)	0.50 oz/100 lbs. cement

2. FORMULA NAME: 4000# W/2S DESCRIPTION: #2 Stone Max Slump 5" 5-7% Air

INGREDIENTS	AMOUNTS
CEMENT	535 lbs.
#2 STONE	580 lbs.
#1 STONE	1100 lbs.
FINE	1533 lbs.
COLD WATER	31 gals.
DARVAIR (air entrainment)	.500/100 lbs. cement
HYCOL (plasticizer, water reducer)	0.50 oz./100 lbs. cement
EXCELORATOR	.00 oz./100 lbs. cement
DARATARD (retarder water reducer)	0.50 oz/100 lbs. cement

PART 3 EXECUTION

3.1 FORMWORK ERECTION

A. Erect formwork, shoring and bracing to achieve design requirements.

B. Camber slabs and framing to achieve ACI 301 tolerances.

C. Provide bracing to ensure stability of formwork.

D. Apply form release agent to formwork in accordance with manufacturer's instructions, prior to placing for accessories and reinforcement.

E. Do not apply form release agent where concrete surfaces will receive applied coverings which are effected by agent.

F. Clean forms as erection proceeds, to remove foreign matter.

3.2 INSERTS, EMBEDDED COMPONENTS, AND OPENINGS

A. Provide formed openings where required for work to be embedded in and passing through concrete members.

B. Coordinate work of other Sections in forming and setting openings, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install concrete accessories straight, level, and plumb.

D. Place formed construction joint device in floor slab pattern pouring sequence.

E. Place joint filler at perimeter of floor slab.

3.3 REINFORCEMENT PLACEMENT

A. Place reinforcement, supported and secured against displacement.

B. Ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings.

3.4 PLACING CONCRETE

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.

B. Install vapor barrier under interior slabs-on-grade. Lap joints minimum 6 inches and seal watertight. Repair damaged vapor barrier with vapor barrier material; lap over damaged areas minimum 6 inches and seal watertight.

C. Separate slabs-on-grade from vertical surfaces with 1/2 inch thick joint filler, extended from bottom of slab to within 1/4 inch of finished slab surface.

D. Place concrete continuously between predetermined expansion, control and construction joints. Do not break or interrupt successive pours such that cold joints occur.

E. Screed floors, slabs-on-grade and concrete base for toppings level, maintaining surface flatness of maximum 1/8 inch in 10 ft.

3.5 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Remove form work progressively and in accordance with code requirements.

3.6 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301.

B. Uniformly spread, screed, and float concrete.

C. Wood float surfaces which will receive ceramic tile with full bed setting system.

D. Steel trowel surfaces, which will receive carpeting, resilient flooring, seamless flooring, thin set ceramic tile or will be left exposed.

E. Maintain surface flatness, with maximum variation of 1/8 inch in 10 ft.

F. In areas with floor drains, maintain floor level at walls and pitch surfaces uniformly to drains.

G. Apply concrete hardener on exposed floor surfaces. Apply in accordance with manufacturer's instructions.

3.7 CURING

A. Apply sealer on floor surfaces in accordance with manufacturer's instructions.

B. Immediately after placement, protect concrete from premature drying.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.8 CONCRETE FINISHING

A. Provide concrete surfaces to be left exposed and concrete walls with smooth rubbed finish.

3.9 FIELD QUALITY CONTROL

A. Inspection and testing will be performed by firm appointed in accordance with Section 01001.

B. Three concrete test cylinders will be taken for every 75 cu yds of each class of concrete placed. At a minimum, three concrete test cylinders will be taken for each day's pour of each class of concrete placed.

C. One additional test cylinder will be taken during cold weather concreting, and be cured on job site under same conditions as concrete it represents.

D. One slump test will be taken for each set of test cylinders taken.

3.10 DEFECTIVE CONCRETE

A. Modify or replace concrete not conforming to required lines, details and elevations, as directed by Architect.

END OF SECTION

SECTION 041000

MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mortar and grout for masonry.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 and ACI 530.1.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

B. Hot Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150, Type I, gray color.

B. Mortar Aggregate: ASTM C144, standard masonry type.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Color: Mineral oxide pigment; color as selected.

E. Grout Aggregate: ASTM C404.

F. Water: Clean and potable.

G. Bonding Agent: Latex Epoxy type.

2.2 MORTAR MIXES

A. Mortar for Load Bearing Walls and Partitions: ASTM C270, Type S using the Property Method.

B. Mortar for Non-load Bearing Walls and Partitions: ASTM C270, Type S using the Property Method.

C. Mortar for Reinforced Masonry: ASTM C270, Type S using the Property Method.

D. Pointing Mortar for Masonry: ASTM C270, Type N, using the Property Method; with maximum 2 percent ammonium stearate or calcium stearate per cement weight.

E. Stain Resistant Pointing Mortar: One part Portland cement, 1/8 part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 percent of Portland cement by weight.

2.3 MORTAR MIXING

A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.

B. Add mortar color and admixtures in accordance with manufacturer's instructions.

C. Do not use anti-freeze compounds to lower the freezing point of mortar.

2.4 GROUT MIXES

A. Bond Beams, Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; premixed type in accordance with ASTM C94, mixed in accordance with ASTM C476 Coarse grout.

2.5 GROUT MIXING

A. Mix grout in accordance with ASTM C94.

B. Do not use anti-freeze compounds to lower the freezing point of grout.

2.6 MIX TESTS

A. Test mortar and grout in accordance with Section 01001.

B. Testing of Mortar Mix: In accordance with ASTM C780.

C. Testing of Grout Mix: In accordance with ASTM C1019.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install mortar and grout in accordance with manufacturer's instructions.

B. Work grout into masonry cores and cavities to eliminate voids. Do not displace reinforcement.

END OF SECTION

SECTION 042000

UNIT MASONRY SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete masonry, reinforcement, anchorage, and accessories.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 and ACI 530.1.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

B. Hot Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Manufacturers:
   1. D'Agostino Building Blocks, Inc.
   2. Duke Concrete Products, Inc.
   3. Zappala Block Co., Inc.

B. Hollow Load Bearing Block Units: ASTM C90, Grade N, Type I - Moisture Controlled; normal weight.

C. Size and Shape: Nominal modular size of 8x8x16 inches. Provide special units for 90 degree corners.

2.2 REINFORCEMENT AND ANCHORAGE

A. Single Wythe Joint Reinforcement: Truss type; steel wire, hot dip galvanized to ASTM A641 Class 3 after fabrication.
   1. Manufacturers:
      a) Durowall
      b) National Wire
      c) Wire Bond

B. Reinforcing Steel: ASTM A615, 60 ksi yield grade, deformed billet bars, uncoated finish.

C. Wall Ties: Triangle tie 3/16 inch thick, adjustable, hot dip galvanized to ASTM A123 uncoated steel finish.

1. Manufacturers:
   a) Durowall
   b) National Wire
   c) Wire Bond

2.3 MORTAR AND GROUT

A. Mortar and Grout: As specified in Section 041000.

2.4 FLASHINGS

A. Plastic Flashings: Sheet polyvinyl chloride.

B. Lap Sealant: Butyl type as specified in Section 079200.

2.5 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, heat fused joints.
   1. Manufacturers:
      a) Durowall
      b) Hohmann & Barnard
      c) Wire Bond
      d) National Wire

B. Joint Filler: Closed cell polyethylene foam; oversized 50 percent to joint width; self expanding.

C. Air Infiltration Barrier - See Section 071900

D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials, recommended by masonry unit manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

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

B. Coordinate placement of anchors supplied to other Sections.

3.2 COURSING

A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

B. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

3.3 PLACING AND BONDING

A. Isolate masonry partitions from vertical structural framing members with a control joint as

indicated.

B. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.4 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY

A. Install horizontal joint reinforcement 16 inches oc. Place joint reinforcement continuous in first and second joint below top of walls.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Reinforce joint corners and intersections with anchors 16 inches oc.

3.5 MASONRY FLASHINGS

A. Extend flashings horizontally at foundation walls, above ledge or shelf angles and lintels, under parapet caps, and at bottom of walls.

B. Turn flashing up minimum 8 inches and bed into mortar joint of masonry.

C. Lap end joints and seal watertight.

D. Turn flashing, fold, and seal at corners, bends, and interruptions.

3.6 LINTELS

A. Install loose steel, lintels over openings.

B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

C. Maintain minimum 8 inch bearing on each side of opening.

3.7 GROUTED COMPONENTS

A. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

B. Place and consolidate grout fill without displacing reinforcing.

C. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.8 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control and expansion joints.

B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant elliptical core with grout fill. Rake joint at

exposed unit faces for placement of backer rod and sealant.

C. Size control joint in accordance with Section 079200 for sealant performance.

D. Form expansion joint as detailed.

3.10 BUILT-IN WORK

A. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames and other items to be built in the work furnished by other Sections.

B. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

3.11 TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

B. Maximum Variation from Level Coursing: 1/8 inch in 3ft and 1/4 inch in 10ft; 1/2 inch in 30ft.

3.12 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, grounds. Coordinate with other sections of work to provide correct size, shape, and location.

3.13 CLEANING

A. Remove excess mortar and mortar smears as work progresses.

B. Clean soiled surfaces with cleaning solution.

END OF SECTION

SECTION 042100

STONE VENEER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cultured Stone Units, reinforcement, anchorage, and accessories.

1.2 SUBMITTALS

A. Samples: Submit four samples of the cultured stone veneer to illustrate color, texture and extremes of color range.

1.3 QUALITY ASSURANCE

A. Comply with BCNYS 2020.

B. Comply with all applicable codes, regulations, and standards. Where provision of applicable codes, regulations, and standards conflict with requirements of this section, the more demanding shall govern.

C. Manufacturer Qualifications:

1. Obtain materials from one manufacturer to ensure compatibility.
2. Obtain materials from company specializing in manufacturing products specified in this section with a minimum 5 years documented experience.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications

B. Hot Weather Requirements: IMIAC - Recommended Practices and Guide Specifications

PART 2 PRODUCTS

2.1 THIN STONE VENEER

A. Manufacturers: Equal to Eldorado Stone – 1 1/2" thick

B. ASTM C 1088, Grade Exterior

C. Modular Size and Shape: Nominal modular size .Provide special units for 90 degree corners.

2.2 REINFORCEMENT AND ANCHORAGE

A. Support System: As per Manufacturer's Instructions for Application to Wood Studs.Related accessories including fasteners, thin tech shims, hardware, air vents, flashing and adhesive

2.3 MORTAR

A. Mortar shall conform to ASTM C 1330 – Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.

1. Type N or S

B. Cold Weather Additives (including accelerators) shall not be used in mix.

2.4 FLASHINGS

A. Plastic Flashings: Sheet polyvinyl chloride.

B. Lap Sealant: Butyl type as specified in Section 07900.

2.5 ACCESSORIES

A. Lath or Mesh in accordance with Manufacturer's Guidelines

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates and foundations as well as rough-in and built-in construction have been properly prepared.

1. Walls must be structurally sound and the substrate system designed with wall deflection not greater than L/360.

B. Verify substrate including, concrete, masonry or framing as well as sheathings, water resistant barriers are properly installed.

C. If substrate, foundations or flashings are the responsibility of another installer, notify Architect and General Contractor of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation. All surfaces must be free of water, snow, dirt, mud, oil and other foreign materials prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install Eldorado Stone in accordance with manufacturers written installation instructions.

B. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement joints, returns, and offsets.

1. Avoid using less-than-half-size units, particularly at corners and jambs.

2. Ensure unfinished or cut faces are not exposed to view upon completion.

C. Select and arrange exposed veneer units to produce a uniform blend of color and texture.

1. Mix units from several pallets as they are placed.

3.4 CLEANING

A. In-Progress Cleaning: Clean units as work progresses by dry brushing to remove grout

B. Final Cleaning: After mortar is thoroughly set and cured, clean as follows:

1. Clean veneer units in accordance with manufacturer's written instructions.

2. Protect adjacent stone and non masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

3. All cleaning practices and product used shall be in accordance with cleaning products manufacturer's written instructions.

END OF SECTION

SECTION 055000

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES, BUT IS NOT LIMITED TO:

A. Elevator Pit Ladder

B. Concrete inserts and fasteners.

C. Structural Steel Lintels

D. Elevator Shaft Hoist Beam

E. Structural Columns and Beams

1.2 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

B. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel Sections: ASTM A36.

B. Steel Tubing: ASTM A500, Grade B. F_y = 46 ksi.

C. Pipe: ASTM A53, Grade B.

D. Sheet Steel: ASTM A446, Grade B Structural Quality with galvanized coating.

E. Bolts, Nuts, and Washers: ASTM A325.

F. Welding Materials: AWS D1.1.

G. Touch-Up Primer for Galvanized Surfaces: FS TT-P-64S.

2.2 FABRICATION - GENERAL

A. Fit and shop assemble in largest practical sections, for delivery to site.

B. Continuously seal joined members by intermittent welds and plastic filler.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, consistent with design of component.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication.

F. Accurately form components required for anchorage of stairs and landings and railings to each other and to building structure.

2.5 FINISHES

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Shop prime items with one coat, two coats on surfaces inaccessible after erection. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Exterior Steel Lintels Etc. to be galvanized to ASTM A123.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

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

B. Make provisions for erection loads with temporary bracing. Keep Work in alignment.

C. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate Sections.

3.2 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads and provide temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated. Perform field welding in accordance with AWS D1.1.

D. Obtain Architect/Engineer approval prior to site cutting.

E. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

END OF SECTION

SECTION 061000

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural floor, wall, and roof framing; built-up structural members; wall and roof sheathing; subfloor sheathing; preservative treatment; sill gaskets.

B. Blocking in wall and roof openings; wood furring and grounds; concealed wood blocking.

1.2 QUALITY ASSURANCE

A. A Grade Mark or Trademark of an Agency certified by the Board of Review of the American Lumber Standards Committee is required on each piece of dimension and board lumber (or bundle in bundled stock).

B. Softwoods: Conform to DOC Simplified Practice Recommendations R-16-53 "American Lumber Standards for Softwood Lumber", PS 20.

C. Plywood: Conform to U.S. Product Standards PS-1.

D. Moisture Content shall not exceed:
1. 19% for lumber (S-Dry);
2. 12% for plywood;
3. 15% for blocking adjacent to finish millwork (MC15).

E. Preservative Treatment to conform to AWPB standards LP-22.

F. Work that is to be exposed, or finished or painted shall be free from defects or blemishes on surfaces that will be exposed to view.

PART 2 PRODUCTS

2.1 DIMENSION LUMBER

A. Rough Lumber: Dressed four (4) sides (S4S), air or kiln dried and surfaced Dry (S-Dry), well seasoned, sound and free from splits, cracks, shakes and wanes; loose or unsound knots, excessive warp, vermin and decay.

B. Douglas Fir-Larch, HemFir, Southern Pine or other locally available species of not less than the following design values:

Size	Grade	Fb	Fv	Fc
1. 2" to 4" thick, 2" x 2" & wider	SPF No. 1/No.2	875	70	1100

2. Beams and lintels	SPF No. 1/No.2	875	70	1100

2.2 GLUE LAMINATED GIRDERS AND HEADERS – MICROLLAMS & PARALLAMS

A. 1 3/4" thick, Fb=2925 psi, E=2,000,000 psi or as noted on the Drawings

B. Each glue lam shall be identified with the grading trademark of the American Institute of Timber Construction.

2.3 BOARDS

A. Non-stress rated.

B. 5/4 and 1 x: No. 3 common pine, fir, spruce.

2.4 TREATED LUMBER

A. Treated lumber shall be used in all locations where the lumber comes in contact with concrete or other cementitious material.

B. Southern Yellow Pine
1. Conforming to requirements of dimension lumber and boards.
2. CCA (soluble salt) pressure treated per AWPB standard LP-22 with 0.40 lbs/cf retention.

2.5 FURRING

A. Merchantable Spruce, 1 x 3 or as indicated.

2.6 FLOOR AND ROOF SHEATHING

A. Each panel of plywood shall be identified with grade-trademark of the American Plywood Association (APA).

B. Grades and thicknesses shall be indicated on drawings and generally as follows:
1. Type A: Floor Sheathing - Sub-floor
One Layer: Huber Advantech Sub-Flooring 25/32" thick Tongue and Groove edges glue screwed or power nailed to the joists/wood trusses.

2. Type B: Roof Sheathing
Huber Advantech Roof Sheathing 5/8" Thick power nailed to Joists/Roof Trusses

3. Type C: Sound Board – (All Wood Floors)
Homosote 440 Sound Barrier Flooring ½" thick

4. Type D: Floor Underlayment – (All Wood Floors) 5.5 mm Underlayment board approved by the resilient flooring manufacturer and contractor equal to Ultraply Underlayment Manufactured by Moreland Company USA.

2.7 FURRING

A. Merchantable Spruce, 1x3 or as indicated.

2.8 WALL SHEATHING

A. Zip System Sheathing, 7/16" thick, with Zip System Tape at all seams.

B. Each panel shall be identified with grade-trademark.

C. Grades and thicknesses shall be indicated on Drawings and generally as follows:
Type A: Exterior Wall Sheathing – Zip Sheathing, 7/16" thick

2.9 ACCESSORIES

A. Fasteners: Galvanized steel for exterior, high humidity, and treated wood locations, plain finish elsewhere.

B. Die Stamped Connectors: Thickness as required, galvanized steel.

C. Joist Hangers: Galvanized steel, sized to suit framing conditions.

D. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

E. Hurricane Ties: Equal to Simpson H Series.

F. Sill Gasket on Top of Foundation Wall: Plate width, closed cell foam or glass fiber strip.

G. Sill Flashing (Under Sill Gasket): Polyethylene sheet.

H. Subfloor Glue: APA AFG-01, water base, waterproof.

I. Wall Sheathing Tape: Zip System Tape at all wall sheathing joints

J. Roof Sheathing "H" Clips

PART 3 EXECUTION

3.1 FRAMING

A. Erect wood framing members in accordance with applicable code. Place members level and plumb. Place horizontal members crown side up. Align regularly spaced first floor studs, floor trusses, second floor studs and roof trusses.

B. Place sill gasket directly on foundation.

C. Frame double joist headers at floor and ceiling openings. Frame rigidly into joists. Frame double joists under wall studding.

D. Bridge joists framing in excess of 8 feet at mid-span members. Fit solid bridging at ends of members.

E. Curb all roof openings except where curbs are provided. Construct curb members of single pieces per side.

F. Install Hurricane Ties 2'-0" O.C. between:
   1. First Floor Ext. Studs & 2nd Fl. Framing.
   2. Second Floor Framing & 2nd Fl. Ext. Studs.

3.2 SHEATHING

A. Install subfloor sheathing perpendicular to floor framing with end joints staggered. Secure sheet edges over firm bearing. Attach sheathing with subfloor glue and screws or shank nails.

B. Install wall sheathing in accordance with the manufacturer's requirements. Secure wall sheathing with ends staggered, over firm bearing. Tape all joints and terminations with Zip System Tape in accordance with the manufacturers requirements.

C. Place vertical sheathing around entire building.

D. Use sheathing "H" clips at joints in the plywood roof sheathing between roof framing members.

3.3 SITE APPLIED WOOD TREATMENT

A. Site apply preservative treatment in accordance with manufacturer's instructions.

B. Treat site-sawn cuts. Brush apply one coat of preservative treatment on untreated wood in contact with cementitious materials.

C. Allow preservative to cure prior to erecting members.

END OF SECTION

SECTION 061753

PLATE CONNECTED WOOD TRUSSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated wood trusses for floor and roof framing.

B. Bridging, bracing, and anchorage.

C. Placement of bearing plates.

1.2 SYSTEM DESCRIPTION

A. Roof Loads

Ground Show Load	50 PSF
Top Dead	25 PSF
Bottom Dead	15 PSF

B. Floor Loads – Apartments

Top Live	40 PSF
Top Dead	10 PSF
Bottom Dead	10 PSF

C. Floor Loads – Corridors and Public Rooms

Top Live	100 PSF
Top Dead	10 PSF
Bottom Dead	10 PSF

D. Deflection limited to 1/360

1.3 SUBMITTALS

A. Shop Drawings: Indicate framing system, sizes and spacing of trusses, loads and truss cambers.

B. Product Data: Provide truss configurations, bearing and anchor details, bridging and bracing.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:
1. Lumber Grading Agency: Certified by ALSC.
2. Plywood Grading Agency: Certified by APA.

B. Truss Design, Fabrication, and Installation: In accordance with Truss Plate Institute BWT-76, HET-80, PCT-80 including Supplement, TPI-85 including Supplement, QST-88.

C. Design joists under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of New York.

PART 2 PRODUCTS

2.1 PLATE CONNECTED WOOD TRUSSES

A. Manufacturers:
1. Alpine Engineered Products, Inc.
2. Inter-Lock Steel

B. Lumber Grading Rules: NFPA, WCLIB, WWPA.

C. Wood Members: Stress Group, species, grade, and size classification: as per manufacturer's recommendations. 19 percent maximum and 7 percent minimum moisture content; single top and bottom chord.

D. Steel Connectors: ASTM A446 steel, Grade A, hot dip galvanized; die stamped with integral teeth; .036 inch thick.

E. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

2.2 ACCESSORIES

A. Wood Framing for Openings: In accordance with Section 06100 softwood lumber, S/P/F species, construction grade.

B. Fasteners: Galvanized steel, type to suit application.

C. Bearing Plates: Galvanized.

2.3 FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Brace wood trusses in accordance with TPI BWT-76.

2.4 WOOD TREATMENT

A. Wood Preservative (Pressure Treatment): AWPA Treatment C1 using water borne preservative with 0.25 percent retainage.

B. Wood Preservative (Surface Application): Clear.

C. Shop preservative treat wood materials indicated, in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that supports and openings are ready to receive trusses.
B. Coordinate placement of bearing support items.

3.2 ERECTION

A. Install trusses in accordance with manufacturer's instructions. Set members level and plumb, in correct position.

B. Make provisions for erection loads and temporary bracing.

C. Do not field cut or alter structural members without approval of Architect.

D. Place headers and supports to frame openings required.

E. Frame openings between trusses with lumber in accordance with Section 06100.

F. Fasten ends of all trusses to exterior wall framing with hurricane clips.

3.3 SITE APPLIED WOOD TREATMENT

A. Brush apply two coats of preservative treatment on wood in contact with cementitious materials, roofing and related metal flashings. Treat site-sawn cuts.

B. Apply preservative treatment in accordance with manufacturer's instructions.

C. Allow preservative to cure prior to erecting members.

END OF SECTION

SECTION 062023

INTERIOR FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finish carpentry items, other than shop prefabricated casework; hardware and attachment accessories.

1.2 DESCRIPTION OF WORK

A. Furnish and install all finish carpentry and millwork, including related hardware required or implied by drawings and/or specifications including:
1. Wood Trim
2. Interior Windows
3. Handrails
4. Shelving
5. Cabinets and Countertops
6. Installation of Miscellaneous Specialties (Section 101005)
7. Installation of toilet and bath accessories (Section 102800)

1.3 INTENT

A. It is not the intent of the Specification to define the types, sizes or installation methods for each item of finish carpentry. Installation, joinery, sizes, types of finish, spacings of nailers, and furring strips shall be done generally in accordance with the details on the drawings for the specific areas involved and in accordance with listed standards; and as approved by the Architect.

B. All Carpentry work and materials not specified elsewhere, but which is implied by the Drawings and/or is required for the work, shall be furnished under the Section whether or not specifically described herein.

1.4 SUBMITTALS

A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, finishes, and accessories.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with AWI Custom quality.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire retardant requirements.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS

A. Softwood Lumber Interior: Graded in accordance with AWI Custom; White Pine species, smooth sawn, maximum moisture content of 6 percent; suitable for good paint finish.

B. Softwood Lumber Exterior: Graded in accordance with AWI Custom; Cedar species, smooth sawn, maximum moisture content of 8 percent; suitable for paint finish.

C. Hardwoods
1. Red oak, select as approved, kiln-dried to 9% moisture content.
2. Prefinished or factory sanded ready for field finish as approved.
3. Sizes and configurations as indicated on drawings.

2.2 SHEET MATERIALS

A. Softwood Plywood: PS 1 Grade A-B; Graded in accordance with AWI, lumber core.

B. Wood Particleboard: ANSI A208.1 Type 1; AWI standard, composed of wood chips made with waterproof resin binders, sanded faces.

2.3 FINISH MATERIALS

A. Plastic Laminate: NEMA LD 3 AWI; 0.040 inch Post Forming 0.050 inch General Purpose quality; color, pattern, and surface texture as selected; manufactured by Wilson-Art, Formica or equal.

B. Laminate Backing Sheet: 0.020 inch Backing Sheet grade, undecorated plastic laminate.

2.4 ACCESSORIES

A. Fasteners: Size and type to suit application; Hot dipped galvanized steel for exterior, high humidity and treated wood locations, plain finish elsewhere.

B. Contact Adhesives: Water Base type.

C. Wall Adhesive: Cartridge type, compatible with wall substrate, capable of achieving durable bond.

D. Primer: Alkyd primer sealer.

2.5 HARDWARE

A. Provide all fasteners including nails, screws, bolts, etc. as indicated, noted or detailed on Drawings and as required to produce a safe, substantial and workmanlike job in all respects.

B. Provide all cabinet and drawer hardware, shelf and other miscellaneous hardware indicated on Drawings.

2.6 FABRICATION

A. Fabricate to AWI Custom standards.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Prime paint surfaces of items or assemblies in contact with cementitious materials, before installation.

3.2 INSTALLATION

A. Install work in accordance with AWI Custom Quality Standard.

B. Set and secure materials and components in place, plumb and level.

C. Install trim by nails.

D. Cover exposed edges of shelving with 3/8 inch thick hardwood edging.

E. Apply plastic laminate finishes with adhesive over entire surface. Apply laminate backing sheet on reverse side of plastic laminate finished surfaces.

F. Install hardware in accordance with manufacturer's instructions.

G. Install miscellaneous specialties and toilet/bath accessories in accordance with the manufacturers instructions.

3.3 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment in accordance with manufacturer's instructions.

B. Brush apply two coats of preservative treatment on wood in contact with cementitious materials and roofing and related metal flashings. Treat site-sawn cuts.

C. Allow preservative to dry prior to erecting members.

3.4 PREPARATION FOR FINISH

A. Sand work smooth and set exposed fasteners. Apply wood filler in exposed fastener indentations.

B. Site Finishing: Refer to Section 099000 Painting.

END OF SECTION

SECTION 071600

BASEMENT AND ELEVATOR PIT WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Liquid Membrane Waterproofing

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with manufacturer's instructions.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperatures above 40 degrees F degrees for 24 hours before application and continuously until dampproofing has cured.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fluid Applied Waterproofing
Sonneborn: Type Hydrocide Liquid Membrane(HLM 5000 and complying with ASTM C-836-84)

B. Expansion Joint Sealant:
Sonneborn Sonalastic NP 1 or NP 2 or SL 2 or SL 1 complying with ASTM C-920.

C. Joint Filler:
Sonneborn Sonofoam Backer-Rod, closed cell polyethylene foam.

D. Reducer:
Sonneborn Reducer 990. For cleaning tools and equipment.

E. Leveling Patcher:
Sonneborn Sonocrete®. An acrylic latex base bonding compound used directly or as an admixture.

F. Joint Filler Strip:
Sonneborn Sonofles F non-impregnated joint filler strip.

G. Cant Strips:
45° to substrate, minimum thickness 1 ½", height 4" maximum, or 1" less than topping thickness.

H. Protection Board:
Sonneborn's Protection Course II premolded protection course or ¼" thick.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that surfaces are solid, free of matter detrimental to adhesion of dampproofing.

B. Do not apply waterproofing to damp, frozen, dirty, dusty, or deck surfaces.

C. Concrete shall be cured for a minimum of 14 days and shall be dry.

3.2 APPLICATION

A. Apply Work in accordance with manufacturer's instructions.

3.3 PROTECTION

A. Within 24 hours after visual inspection and/or repairs, cover membrane with protection board. All horizontal and vertical membrane shall be protected.

B. Cleaning:
Upon completion of this work, all materials, containers, equipment and debris shall be removed. Area shall be left in clean condition.

END OF SECTION

SECTION 071900

VAPOR AND AIR BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Underslab Vapor Barrier.

B. Sill and Wall Air Infiltration Barrier.

C. Flexible Flashing

D. Attic Vapor Barrier – See Section 07210

1.2 SYSTEM DESCRIPTION

A. Products of this Section to achieve continuity of building enclosure air and vapor barrier, in conjunction with materials in Section 07210.

B. Sheet and sealing materials to seal gaps between building enclosure components.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Underslab Barrier: Stego Wrap 15 mil Class A or Equal – See Geotechnical Report

B. Wall Air Infiltration Barrier: Zip Sheathing System – See Specification Section 06100

C. Flashing Membrane Material: Equal to Grace Vycor Self Adhering Flashing Systems and Zip Tape System as noted on the Drawings.

2.2 ACCESSORIES

A. Nails and tape as recommended by the barrier manufacturer.

PART 3 EXECUTION

3.1 UNDERSLAB VAPOR BARRIER

A. Apply one ply of plastic sheet over subgrade with edges lapped 6 inches (approx).

B. Cut and fit neatly as required to accommodate all work of other tasks.

C. Tape all joints and penetrations to provide continuous, unbroken membrane.

3.2 SILL AND WALL INFILTRATION BARRIER

A. Apply air infiltration barrier in accordance with the manufacturers' recommendations.

B. All exterior wall penetrations (i.e., outlets, etc.) are to be properly sealed.

3.3 ZIP SHEATHING TAPE & FLASHING MEMBRANE

A. Prior to the start installation conduct a pre-installation meeting with the builder, flashing membrane manufacturer.

B. Install flashing membrane at locations indicated on the drawings and at other locations as may be required in accordance with the manufacturers requirements.

END OF SECTION

SECTION 072100

BUILDING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rigid Foam Insulation
B. Batt Thermal Insulation in the Attic and Exterior Walls
C. Poly Iso Insulation – See Section 075323: Single Membrane Roofing
D. Acoustic Insulation - See Section 092900.

1.2 SYSTEM DESCRIPTION

A. System performance to provide continuity of thermal and vapor barrier at building enclosure elements in conjunction with vapor and air barrier materials in Section 071900.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Install insulation adhesives in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

A. Extruded Polystyrene Rigid Foam Insulation, Exterior Walls: ASTM C578 Type V, Equal to Foamular 250 manufactured by Owens Corning Foam Insulation, LLC, conforming to the following:

Thermal Resistance	R of 5.0 /inch
Thickness	2 inches or as noted
Compressive Strength Minimum	25 psi
Water Vapor Permeance	1.1 perm @ 1 inch
Edges	Square

B. Batt Insulation, Attic:ASTM C665; preformed glass fiber batt, friction fit; manufactured by Owens-Corning Fiberglass Corp., or Certainteed, conforming to the following:

Thermal Resistance	R-49
Thickness	15 inches
Facing	Kraft Paper

2.2 ADHESIVES

A. Adhesive: Type recommended by insulation manufacturer for application.

2.3 ACCESSORIES

A. Vapor and Air Barrier: As specified in Section 07190.
B. Tape: As recommended by the insulation manufacturer.

C. XPS Insulation Tape : Joint SealR Foam Joint
D. Insulation Fasteners: As recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation, and adhesive.

3.2 INSTALLATION – FOUNDATION PERIMETER – BOARD INSULATION

A. Adhere a strip of polyethylene sheet over substrate joints with beads of adhesive. Tape seal joints.

B. Apply same adhesive and install boards on foundation perimeter. Stagger joints. Butt edges and ends tight to adjacent board and to protrusions.

3.3 INSTALLATION - BATT INSULATION

A. Install insulation in accordance with insulation manufacturer's instructions.

B. Install in exterior walls, and attic spaces without gaps or voids.

C. Fit insulation tight in spaces. Leave no gaps or voids.

D. Exterior Wall, Attic: Install friction fit insulation tight to framing members, completely filling prepared spaces.

E. Retain insulation in place with wood strapping.

F. Coordinate vapor and air barrier seal with Section 071900.

END OF SECTION

SECTION 073113

ASPHALT ROOF SHINGLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Granular surfaced asphalt shingle roofing, underlayment, eave, valley, and ridge protection, with metal flashings.

1.2 SUBMITTALS

A. Product Data: Provide data indicating material characteristics, and limitations.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Steep Roofing Manual.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not install eave ice dam edge protection and shingles when ambient temperatures are below 50 degrees F.

PART 2 PRODUCTS

2.1 ASPHALT SHINGLES

A. Manufacturers and series equal to:
GAF Timberline 30 (30 Year).
Tamko – Heritage 30 (30 Year).
Certainteed Landmark 30 (30 Year)

B. Asphalt Shingles: ANSI/ASTM D3018, Class A with Type I - Self Sealing; UL Rating of A and Wind Resistance Label, glass fiber mat base, mineral granule surface type; 250 lb/square; standard self sealing type; square; color as selected.

2.2 SHEET MATERIALS

A. Eave and Valley Ice Dam Protection: Sheet barrier of rubberized asphalt bonded to sheet polyethylene, 40 mil total thickness, with strippable treated release paper.

B. Underlayment: 15 pound asphalt paper.

2.3 ACCESSORIES

A. Nails: Standard round wire shingle hot dipped zinc coated steel type, of sufficient length to penetrate roof sheathing.

B. Plastic Cement: Asphalt type with mineral fiber components.

C. Lap Cement: Fibrated cutback asphalt type.

2.4 FLASHING MATERIALS

A. Sheet Flashings: See Section 07620

B. Drip Edge Flashing: .032 Break formed aluminum sheet. Standard enamel finish. Color to be selected by the Architect.

C. Bituminous Paint: Acid and alkali resistant type; black color.

D. Nails: Standard round wire roofing type, hot dipped zinc coated steel; of sufficient length to penetrate wood substrate.

2.5 FLASHING FABRICATION

A. Form flashings to protect roofing materials from physical damage and shed water.

B. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.

C. Hem exposed edges of flashings minimum 1/4 inch on underside.

D. Apply bituminous paint on concealed surfaces of flashings.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that plumbing stacks and roof penetrations are flashed to deck surface.

B. Verify deck surfaces are dry, free of ridges, warps, or voids. Broom clean surfaces.

C. Fill knot holes and surface cracks with latex filler at areas of bonded eave protection.

3.2 INSTALLATION - EAVE ICE DAM PROTECTION

A. Place eave and gable edge metal flashings tight with fascia boards. Weather lap joints and seal with plastic cement. Secure flange with nails.

B. Apply rubberized asphalt/polyethylene sheet eave protection in accordance with manufacturer's instructions.

C. Extend eave ice dam protection membrane minimum 3 ft minimum upslope beyond interior face of exterior wall, (5'minimum total width).

D. In areas where the roof pitch is 3 ½ :12 or lower install additional Ice Dam protection as may be required by the shingle manufacturer.

3.3 INSTALLATION - PROTECTIVE UNDERLAYMENT

A. Place one ply of underlayment over area not protected by eave protection, with ends and edges weather lapped and nailed. Stagger end laps of each consecutive layer.

B. Install perpendicular to slope of roof.

C. Weather lap and seal watertight with plastic cement, items projecting through or mounted on roof.

3.4 INSTALLATION - METAL FLASHING

A. Weather lap joints and seal weather tight with plastic cement. Secure in place with concealed fastenings.

B. Flash and seal work projecting through or mounted on roofing with plastic cement, weather tight.

3.5 INSTALLATION - ASPHALT SHINGLES

A. Install shingles in accordance with manufacturer's instructions.

B. Provide triple course of shingles at eaves.

C. Place shingles in straight coursing pattern with required weather exposure to produce triple thickness over full roof area.

D. Project first course of shingles 3/4 inch beyond eave boards.

E. Extend shingles 1/2 inch beyond face of gable edge fascia boards.

F. Cap hips and ridges with individual shingles, maintaining weather exposure. Place to avoid exposed nails.

G. After installation, place one daub of plastic cement, under each individual shingle exposed to weather, to prevent lifting.

H. Complete installation to provide weather tight service.

END OF SECTION

SECTION 074600

SIDING & RELATED TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Trims, Brackets, Etc.

B. Porch soffits

C. Vinyl Siding, & Trim.

D. Vinyl Shake Siding

E. Siding Trim Accessories

F. Cellular PVC Trim and Mouldings.

1.2 SUBMITTALS

A. Product Data: Provide data indicating materials, component profiles, fastening methods, jointing details, sizes, surface texture, finishes, and accessories.

B. Samples: Submit two samples 12 x 12 inch in size illustrating surface texture and color.

C. Submit two additional samples to Section 09900 for application of paint.

1.3 WARRANTY

A. Provide five-year warranty.

PART 2 PRODUCTS

2.1 MATERIALS

A. Soffits (Vented)
Manufacturers: Equal to Certainteed Triple 3 1/3" Invisivent

B. Vinyl Siding:
1. Siding
Equal to Certainteed Monogram 46 Double 4"- Color: : To be Determined

C. Vinyl Shake Siding
1. Equal to the Certainteed – Double 7" Straight Edge Perfection Shingles Standard Color – (2nd Floor Walls), Deluxe Color (Gable Ends)

D. Siding Trim – Accessories
1. Fascia and Trim
Equal to Restoration Millwork smooth finish – thickness and size as indicated on the drawings

2. Door and Window – thickness and size as indicated on the drawings
   Lineal Surrounds
   Equal to: Restoration Millwork 3 ½" Wide at Sides and under sill, 4 ½" wide with brick mold at head
3. Corner Trim
   Equal to: Restoration Millwork 5/4" x 6" x 6"
4. Mounting Blocks
   Equal to: Mid-America Mount master Mounting Blocks
   Provide mounting blocks for all light fixtures, exterior outlets, hose bibbs, electric meters, etc. Size as required. Color to match siding.
5. Exhaust Vents
   Equal to: Mid-America Master Intake/Exhaust Vent
   Color to match siding.
   See Heating Drawings for Vent Locations
6. Rectangular Gable Vents
   Equal to: Mid America – Specialty Gable Vent – Size as noted on the building elevations - Color: white
7. Porch Posts - Wrap
   Equal to: Certainteed Column Wraps, 8" x 8" x 9 1/0", with Classic Trim Kit.
8. Other – Certainteed Resoration Millwork

F. Cellular PVC Trim and Mouldings Trim
   Equal to Certainteed Restoration Millwork Trim and Mouldings

2.2 ACCESSORIES

A. Nails: Corrosion resistant type, aluminum, non-staining, pre-finished to match siding finish.

B. Accessory Components: Siding and Soffit: All accessories required by the siding\soffit manufacturer for a complete installation.

C. Trim and Moulding Adhesive: Type Recommended by the Manufacturer

D. Prime and Finish Paint: See Section 09900.

2.3 FINISH

A. Paint Finish – Colors to be selected by the Architect.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install siding, soffits trim and mouldings in accordance with manufacturer's instructions.

B. Install siding using single course method; with 5 inch exposure. Nail siding at 12 inches o.c. into studs or Zip-R-Sheathing. Miter horizontal joints tight at 45 degrees.

C. Nail to an aligned pattern.

D. Install siding for natural watershed.

E. Align level, and plumb. Locate cut board edges and ends over bearing.

F. Install metal flashings at internal and external corners sills, head of wall openings and horizontal joints of sheet materials.

G. Install sealant to prevent weather penetration. Maintain neat appearance.

3.2 PREPARATION FOR SITE FINISHING

A. Sand work smooth and set exposed nails.

END OF SECTION

SECTION 075323

SINGLE MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Elastomeric Sheet Membrane Conventional Roofing System with insulation fully adhered, roofing membrane wall flashings, edge flashings, roof penetration flashings, roof accessories, etc. as may be required for a complete roofing system.– see Roof Plan Drawing

B. Poly Iso Insulation (Dining Room Roof only)

1.2 SUBMITTALS

A. Product Data: Provide characteristics on membrane materials, flashing materials, insulation.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with Underwriters Laboratories Inc. (UL) Class A Fire Hazard Classification.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not install membrane during inclement weather or when air temperature may fall below 40° F.

1.5 WARRANTY

A. Provide a Fifteen Year Manufacturer's Full System Warranty for labor & materials (no dollar limit) under provisions of Section 01001 including coverage of materials and installation and resulting damage to building resulting from failure to resist penetration of moisture.

B. In addition to the Manufacturer's Warranty described in Item A the roofing contractor shall provide a Two Year Labor and Material Warranty for all roofing and sheetmetal work.

1.6 WIND LOADS

A. The Roofing System shall conform to the requirements for Wind Loads as described in BC 1609 and BC1504.2, 1504.3 and 1504.4.

PART 2 PRODUCTS

2.1 MEMBRANE MATERIALS

A. Equal to Firestone fully adhered roofing system with standard rubberguard EPDM in 60 mil thickness with ½" thick recovery board. Run flashing up parapet wall.

2.2 MEMBRANE FASTENING

A. Membrane Adhesive: Type recommended by membrane manufacturer.

B. Insulation Adhesive: Type recommended by insulation manufacturer.

2.3 INSULATION MATERIALS

A. Manufacturers: Acceptable to the roofing manufacturer.

B. Recovery Board: As recommended by insulation manufacturer.

C. Poly Iso Insulation (Dining Room): Six inch (6"), R value 39.5

D. Insulation Adhesive: As recommended by insulation manufacturer.

E. Insulation Joint Tape: As recommended by insulation manufacturer.

2.4 ACCESSORIES

A. Flexible Flashings: Same material as membrane.

B. Prefabricated Control or Expansion Joint Flashing: Sheet butyl, foam filler, and metal edges flashings.

C. Cant Strip: As Recommended by Roofing Manufacturer.

D. Any other materials required by the roofing manufacturer for a complete installation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work; wood deck is clean and smooth, free of snow or ice; properly sloped to drains.

B. Verify roof openings, curbs, and protrusions through roof are solidly set; wood cant strips and reglets are in place.

3.2 RECOVERY BOARD APPLICATION

A. Embed into insulation adhesive and mechanically fasten board to deck in accordance with manufacturer's instructions.

B. Lay boards with edges in moderate contact without forcing. Cut to fit neatly to perimeter blocking and around penetrations through roof.

3.3 MEMBRANE APPLICATION

A. Apply membrane in accordance with manufacturer's instructions.

B. Seal items penetrating membrane with counterflashing membrane material. Install membrane flashings. Seal watertight to membrane.

C. Apply roof control and expansion joint materials to isolate roof into areas as indicated.

3.4 FLASHINGS AND ACCESSORIES

A. Apply flexible flashings to seal membrane to vertical elements.

B. Install roofing control joints to isolate roof into areas as indicated in accordance with manufacturer's instructions.

C. Coordinate installation of roof drains and related flashings.

D. Seal flashings and flanges of items penetrating membrane.

END OF SECTION

SECTION 076200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof flashings.

B. Roof Drip Edge

C. Counterflashings over base flashings and vent stacks.

D. Gutters and Downspouts

1.2 QUALITY ASSURANCE

A. SMACNA - Architectural Sheet Metal Manual.

1.3 STORAGE AND HANDLING

A. Stack preformed and pre-finished material to prevent twisting, bending, or abrasion, and to provide ventilation.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Aluminum Sheet: ASTM B209, 3003 alloy, H14 temper; .05ga thick; mill shop pre-coated with standard coating. Color: Standard color as selected by the Architect.

2.2 GUTTERS AND DOWNSPOUTS

A. Equal to ATAS 5" "K" Gutters

2.3 ACCESSORIES

A. Fasteners: Aluminum.

B. Underlayment: See Section 07525 and Section 07311.

C. Protective Backing Paint: Zinc chromate alkyd.

D. Sealant: Acrylic type, specified in Section 07900.

E. Bedding Compound: Rubber-asphalt type.

F. Plastic Cement: Asphaltic base cement.

2.4 FABRICATION

A. Form components true to shape, accurate in size, square, and free from distortion or defects. Form pieces in longest practical lengths.

B. Fabricate cleats and starter strips of same material as sheet, minimum 4 inch wide, interlockable with sheet.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

D. Fabricate flashings to allow toe to extend 2 inches over roofing. Return and brake edges.

E. Form material with standing seam.

F. Fabricate corners in one piece; seam for rigidity, seal with sealant.

G. Form sheet metal pans with upstand, and flanges. Fill pans watertight with plastic cement.

2.5 FINISH

A. Backpaint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify roof openings, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips in place, and nailing strips located.

B. Verify membrane termination and base flashings are in place, sealed, and secure.

3.2 INSTALLATION

A. Conform to drawing details included in SMACNA manual.

B. Install starter and edge strips, and cleats.

C. Secure flashings using concealed fasteners.

D. Apply plastic cement compound between metal work and felt flashings.

E. Fit components tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

F. Seal metal joints watertight.

G. Install Gutters and Downspouts (Leaders) at locations indicated on the Drawings in accordance with the Manufacturer's recommendations.

END OF SECTION

SECTION 078400

FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Firestopping systems, materials and accessories.

B. Fire Stop Sealant & Rated Joint Sealant

1.2 SYSTEM DESCRIPTION

A. Provide firestop systems consisting of a material, or combination of materials installed to retain the integrity of fire resistance rated construction by maintaining an effective barrier against the spread of flame, smoke and/or hot gases through penetrations, fire resistive joints, and perimeter openings in accordance with the requirements of the Building Code for this project.

B. Firestop systems shall be used in locations including, but not limited to, the following:
   1. Penetrations through fire resistance rated roof assemblies.
   2. Penetrations through fire resistance rated wall assemblies.
   3. Membrane penetrations in fire resistance rated wall assemblies.
   4. Joints between fire resistance rated assemblies.
   5. Perimeter gaps between rated roofs and an exterior wall assembly.

1.3 REFERENCES

A. American Society For Testing and Materials Standards (ASTM):
   1. ASTM E 84: Standard Test Method For Surface Burning Characteristics of Building Materials.
   2. ASTM E 814: Standard Test Method For Fire Tests of Through-Penetration Firestops.
   3. ASTM E 1966: Test Method For Resistance of Building Joint Systems.
   4. ASTM E 1399: Test Method for Cyclic Movement and Measuring Minimum and Maximum Joint Width.
   5. ASTM E 119: Methods of Fire Tests of Building Construction and Materials.
   6. ASTM E 2307: Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus
   7. ASTM E 2174: Standard Practice for On-Site Inspection of Installed Fire Stops
   8. ASTM E 2393: Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

B. Underwriters Laboratories Inc. (UL):
   1. UL 263: Fire Tests of Building Construction and Materials.
   2. UL 723: Surface Burning Characteristics of Building Materials.
   3. UL 1479: Fire Tests of Through-Penetration Fire Stops.
   4. UL 2079: Tests for Fire Resistance of Building Joint Systems.

C. UL Fire Resistance Directory -Volume 2:
   1. Through-Penetration Firestop Devices (XHJI)
   2. Fire Resistive Ratings (BXUV)
   3. Through-Penetration Firestop Systems (XHEZ)
   4. Fill, Void, or Cavity Material (XHHW)

D. Omega Point Laboratories (OPL)
   1. Directory of Listed Building Products, Materials & Assemblies – Volume II

1.4 DEFINITIONS

A. Firestopping: The use of a material or combination of materials in a fire-rated structure (wall or floor) where it has been breached, so as to restore the integrity of the fire rating of that wall or floor.

B. System: The use of a specific firestop material or combination of materials around a specific penetrant(s) or into a specific joint in conjunction with a specific wall and/or floor construction type.

C. Barrier: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.

D. Through-penetration: Any penetration of a fire-rated wall that completely breaches the barrier.

E. Membrane-penetration: Any penetration in a fire-rated wall that breaches only one side of the barrier.

F. Fire Resistive Joint: Any gap, joint, or opening, whether static or dynamic, between two fire-rated barriers including where the top of a wall meets a floor; wall edge to wall edge configurations; floor edge to floor edge configurations; floor edge to wall configurations.

G. Perimeter Barrier: Any gap, joint, or opening, whether static or dynamic, between a fire-rated floor assembly and a non-rated exterior wall assembly.

H. Engineering Judgment: A firestopping assembly proposed for conditions where a tested and listed firestopping system does not exist.

1.5 PERFORMANCE REQUIREMENTS

A. Penetrations: Provide through-penetration firestop systems that are produced and installed to resist the spread of fire, passage of smoke and other hot gases according to requirements indicated, to restore the original fire-resistance rating of barrier penetrated.
   1. Provide and install complete penetration firestopping systems that have been tested and approved by nationally accepted testing agencies per ASTM E 814 or UL 1479 fire tests in a configuration that is representative of field conditions.
   2. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814 or UL 1479, but not less than one (1) hour or the fire resistance rating of the barrier being penetrated.
   3. T-Rated Systems: Provide through-penetration firestop systems with T-ratings indicated,

as well as F-ratings, as determined per ASTM E 814 or UL 1479, where required by the Building Code.

4. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
5. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

B. Fire Resistive Joints: Provide joint systems with fire resistance assembly ratings indicated, as determined by UL 2079 (ASTM E 1399 and E 1966), but not less than the fire resistance rating of the construction in which the joint occurs. Firestopping assemblies must be capable of withstanding anticipated movements for the installed field conditions.
   1. For firestopping assemblies exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

C. Firestopping products shall have flamespread ratings less than 25 and smoke-developed ratings less than 450, as determined per ASTM E 84.

1.6 SUBMITTALS

A. Product Data: For each type of firestopping product selected. Certify that firestopping materials are asbestos free and contain volatile organic compounds (VOCs) within limits of the local jurisdication.

B. Design Listings: Submit system design listings, including illustrations, from a qualfied testing and inspecting agency that is applicable to each firestop configuration.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Submit document from manufacturer wherein manufacturer recognizes the installer as qualified.

1.7 QUALITY ASSURANCE

A. Provide firestopping system design listings from UL or OPL in accordance with the appropriate ASTM Standard(s) per article 1.5.

B. Contractor Qualifications: An acceptable installer shall meet any two of the following requirements:
   1. Trained and approved by the firestop manufacturer,
   2. Shown to have successfully completed not less than 5 comparible scale projects.

C. Single Source Limitations: Obtain firestop systems, for each kind of penetration and construction condition indicated from a single manufacturer, where possible.

D. Materials from different firestop manufacturers shall not be installed in the same firestop system or opening.

E. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.

F. Firestopping sealants must be flexible, allowing for normal pipe movement.

G. Firestopping materials shall not crack or pull back from contact surfaces such that a void is created.

H. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.

I. Materials used shall be in accordance with the manufacturer's written installation instructions.

J. Label each firestopping system installation with the following information:
   1. Firestopping product name
   2. System listing number
   3. Name and address of manufacturer

K. Inspection of penetrations through fire rated wall assemblies shall be in accordance with ASTM E 2174, Standard Practice for On-Site Inspection of Installed Fire Stops.

L. Inspection of fire resistive joints and perimeter barriers shall be in accordance with ASTM E 2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture, lot number, UL or OPL classification marking, and mixing instructions for multi-component materials.

B. Store and handle materials per manufacturer's instructions to prevent deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

C. All firestop materials shall be installed prior to expiration of shelf life.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Install firestopping when ambient or substrate temperatures are within limits permitted by the manufacturer's written instructions. Do not install firestopping when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate per the manufacturer's written instructions on the product's Material Safety Data Sheet.

C. Verify the condition of the substrates before starting work.

D. Care should be taken to ensure that firestopping materials are installed so as not to contaminate adjacent surfaces.

1.10 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that firestopping assemblies are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Do not conceal firestopping installations until the Owner's inspection agency or Authorities Having Jurisdiction have examined each installation.

D. Schedule firestopping after installation of penetrants but prior to concealing the openings.

PART 2 – PRODUCTS

2.1 FIRESTOPPING, GENERAL

A. Firestopping products specified in system design listings by UL or OPL may be used providing they conform to the construction type, penetrant type, annular space requirements and fire rating involved in each separate assembly.

B. Manufacturer of firestopping products shall have been successfully producing and supplying these products for a period of not less than three years and be able to show evidence of at least ten projects where similar products have been installed and accepted.

C. Accessories: Provide components for each firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by the firestopping manufacturer and approved by UL or OPL for the firestop systems indicated. Accessories include, but are not limited to the following items:
   1. Permanent forming/damming/backing materials, including the following:
      i. Mineral wool insulation.
      ii. Foams or sealants used to prevent leakage of fill materials in liquid state.
      iii. Fire-rated form board.
      iv. Polyethylene/polyurethane backer rod.
      v. Rigid polystyrene board.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Steel sleeves

D. All firestopping products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.

2.2 MIXING

A. For those products requiring mixing before application, comply with firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

2.3 MANUFACTURERS

A. Subject to compliance with the requirements, provide products by the following:
   1. Equal to Grace Construction Products, 62 Whittemore Ave, Cambridge MA 02140, (866) 333-3726.

2.4 MATERIALS

A. Intumescent Firestop Sealants and Caulks:
   1. Equal to Grace FlameSafe FS1900

B. Elastomeric Water-Based Sealant
   1. Equal to Grace FlameSafe FS1900, FS900+

C. Elastomeric Silicone Sealant

D. Equal to Grace FlameSafe Silicone

E. Firestop Putty:
   1. Equal to Grace FlameSafe FSP1000 Putty & FSP1077 Putty Pads

F. Firestop Devices:
   1. Equal to Grace FlameSafe FSWSD Collar, FSIS Intumescent Sleeve, FlameSafe FSD Device

G. Wrap Strips:
   1. Equal to Grace FlameSafe FSWS 100 Wrap Strip, FSWS 150 Wrap Strip

H. Firestop Mortars:
   1. Equal to Grace FlameSafe FSM Mortar

I. Firestop Bags/Pillows:
   1. Equal to Grace FlameSafe Bags, FlameSafe Pillows

J. Elastomeric Coating:
   1. Equal to Grace FlameSafe FS3000

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verify that all pipes, conduits, cables, and/or other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing firestop systems to comply with written recommendations of firestopping manufacturer and the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of firestop systems.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestop systems. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

3.3 PENETRATION FIRESTOP SYSTEMS

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" article in Part 1 and firestopping manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Installation of firestopping shall be performed by an applicator/installer qualified as described in article 1.7.

C. Apply firestopping in accordance with UL or OPL listed system designs or manufacturer's EJ per the manufacturer's installation instructions.

D. Install forming/damming/backing materials and other accessories required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire resistance ratings required.

E. Install fill materials for firestop systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they fully contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 JOINT FIRESTOP SYSTEMS

A. General: Install fire resistive joint firestop systems to comply with "Performance Requirements" article in Part 1 and firestopping manufacturer's written installation instructions and published drawings for products and applications indicated. Fire resistive joint systems to comply with Section 07842 , "Head-of-Wall Joint System" wherever applicable.

B. Installation of firestopping shall be performed by an applicator/installer qualified as described in article 1.7.

C. Apply firestopping in accordance with UL or OPL listed system designs or manufacturer's EJ per the manufacturer's installation instructions.

D. Install joint forming/damming materials and other accessories required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths of installed firestopping material relative to joint widths that allow optimum movement capability and achieve fire resistance ratings required.

E. Install fill materials for firestop systems by proven techniques to produce the following results:
   1. Fill joint as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they fully contact and adhere to substrates forming the openings.

3. Completely fill recesses provided for each joint configuration.
4. Tool non-sag firestop materials after their application and prior to the time skinning begins. Use tooling agents approved by the firestopping manufacturer.

3.5 PERIMETER BARRIER FIRESTOP SYSTEMS

A. General: Install perimeter barrier firestop systems to comply with "Performance Requirements" article in Part 1 and firestopping manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Installation of firestopping shall be performed by an applicator/installer qualified as described in article 1.7.

C. Apply firestopping in accordance with UL or OPL listed system designs or manufacturer's EJ per the manufacturer's installation instructions.

D. Install metal framing, mechanical attachments, safing materials and firestop materials as applicable within the system design.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by firestopping manufacturer(s) and that do not damage materials in which openings occur. Leave finished work in neat, clean condition with no evidence of spillovers or damage to adjacent surfaces.

B. Provide final protection and maintain conditions during and after installation that ensure firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestop systems immediately and install new materials to produce firestop systems complying with specified requirements.

END OF SECTION

SECTION 079200
JOINT SEALERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparing sealant substrate surfaces.

B. Sealant and joint backing.

1.2 SYSTEM DESCRIPTION

A. System performance to achieve moisture and air tight joint seals.

1.3 SUBMITTALS

A. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and colors available.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform acoustical sealant application work in accordance with ASTM C919.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature & humidity recommended by the sealant manufacturer during & after installation.

PART 2 PRODUCTS

2.1 SEALANTS

A. Exterior Joint Sealant: Two-part, non-sag low modulus polyurethane rubber sealant; ASTM C-920-87, Type M, Grade NS Class 25.

B. Exterior Threshold Sealant: Single component, solvent release, non-skinning non-sagging sealant. ASTM C-920.

C. Interior Joint Sealant: One part, non-sag acrylic latex caulking compound. ASTM C834-91.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: ASTM D1056; round, closed cell polyethylene foam rod.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that substrate surfaces and joint openings are ready to receive work.

B. Remove loose materials and foreign matter which might impair adhesion of sealant.

C. Verify that joint backing and release tapes are compatible with sealant.

D. Perform preparation in accordance with ASTM C804 for solvent release and ASTM C790 for latex base sealants.

3.2 INSTALLATION

A. Clean joints in accordance with manufacturer's instructions.

B. Install sealant in accordance with manufacturer's instructions.

C. Measure joint dimensions and size materials to achieve required width/depth ratios.

D. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.

E. Install bond breaker where joint backing is not used.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Tool joints concave.

3.3 SCHEDULE

	Location	Type	Color
A.	Window perimeter (Exterior)	A	To match window trim
B.	Vinyl Siding (Exterior)	A	To match siding
C.	Door Frame/Walls-Exterior	A	To match door trim
	Door Frame/Walls-Interior	C	To match door trim
D.	Under Thresholds	B	Black
E.	Toilets, Bathtubs, Showers/Ceramic Tile & Vinyl Flooring	C	White
F.	Joints at Intersections of Dissimilar Materials		To Be Selected by the Architect
	Exterior	A	
	Interior	C	
G.	Countertop Backsplash and Sides	C	To Be Selected by the Architect

END OF SECTION

SECTION 081113

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel doors and frames; non-rated and fire rated.

1.2 SUBMITTALS

A. Shop Drawings: Indicate door and frame elevations, internal reinforcement, cut-outs for glazing, and finish.

B. Product Data: Indicate door and frame configurations, location of cut-outs for hardware reinforcement.

1.3 QUALITY ASSURANCE

A. Conform to the following:
1. SDI-100 - Standard Steel Doors and Frames.
2. DHI - Door Hardware Institute - The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.
3. Fire Rated Door and Frame Construction: ASTM E152
4. Handicapped: ANSI A117.1.

B. Certification: All steel doors and frames shall be delivered to the site bearing the certification label of conformance to Steel Door Institute (SDI) Standards.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

A. Manufacturers:
1. Ceco Door Products
2. Benchmark Metal Doors and Frames
3. Curies Hollow Metal Doors and Frames, Series 707N
Style as indicated on the Door Schedule.

B. Exterior Doors: SDI-100 Grade II. Galvanized.

C. Interior Doors: SDI-100 Grade II.

D. Exterior Frames: 16 gage galvanized thick material, core thickness.

E. Interior Frames: 18 gage thick material, core thickness.

F. Door Core: As indicated on the Door Schedule

G. Thermal Insulated Door: Total insulation R value of 15 (Solid Door).

H. Sound Rated Door: STC of 22, measured in accordance with ASTM E413.

2.2 ACCESSORIES

A. Silencers: Resilient rubber.

B. Primer: Zinc chromate.

2.3 FABRICATION - DOORS

A. Fabricate doors with hardware reinforcement welded in place.

B. Attach fire rated label to each rated door unit. (See Door Schedule).

2.4 FABRICATION - FRAMES

A. Fabricate frames as knock down units.

B. Fabricate frames with hardware reinforcement plates welded in place.

C. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

D. Prepare frame for silencers and install.

2.5 FINISH

A. Steel Sheet: Galvanized to ASTM A525 G60.

B. Primer: Baked.

C. Coat inside of frame profile with bituminous coating.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install doors and frames in accordance with ANSI/SDI-100.

B. Coordinate installation of doors and frames with installation of hardware specified in Section 08710.

C. Coordinate with wallboard construction for frame anchor placement.

D. Install door louvers, plumb and level.

E. Coordinate installation of glass and glazing.

3.2 TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.3 SCHEDULE - See Door Schedule.

END OF SECTION

SECTION 081416

WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wood doors; fire rated and non-rated.

1.2 SUBMITTALS

A. Shop Drawings: Indicate door elevations and cutouts for hardware and channel edge protectors.

1.3 QUALITY ASSURANCE

A. Perform work in accordance with the following:
   1. ANSI/NWWDA I.S.1.
   2. Fire Door Construction: Conform to ASTM E152.
   3. Installed Door Assembly: Conform to NFPA 80 for 45-minute fire rating as indicated on the Door Schedule.

B. Certification: All wood doors shall be delivered to the site bearing the certification label to ANSI/NWWDA I.S.1 Standards.

1.4 WARRANTY

A. Provide warranty under provisions of Section 010001 to the following term:
   1. Interior Doors: Two (2) years.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 WOOD DOORS

A. Manufacturers
   1. Mohawk Door Co., Inc.
   2. Fenestra Corporation
   3. Doorcraft Doors by Jeld-Wen

2.2 DOOR TYPES

A. Interior Doors: 1-3/8 inches thick; Hollow Core

B. Interior Doors: 1-3/8 inches thick Solid Core; Non-Rated

2.3 DOOR CONSTRUCTION

A. Core
   1. Hollow Core: Honey comb Hollow Cellular Paper Core (NWWDA I.S.1)
   2. Solid Core: Non-Rated Profiled Particle Board Core

B. Face
   1. Two (2) Panel embossed hardboard Craftmaster Carrara Style – Smooth Finish

2.4 FABRICATION

A. Fabricate non-rated doors in accordance with ANSI/NWWDA I.S.1 requirements.

B. Fabricate fire rated doors in accordance with ANSI/NWWDA I.S.1 and to Warnock-Hersey requirements. Attach fire-rating label to door edge.

C. Fabricate doors with hardware reinforcement blocking in place.

D. Factory machine doors for finish hardware.

E. Doors to be pre-finished.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install doors in accordance with manufacturer's instructions/NWWDA I.S.1 requirements.

B. Coordinate installation of doors with installation of frames specified in Section 081113 and hardware specified in Section 087100.

C. Adjust door for smooth and balanced door movement.

3.2 INSTALLATION TOLERANCES

A. Conform to ANSI/NWWDA requirements for fit and clearance tolerances and maximum diagonal distortion.

3.3 SCHEDULE - See Door Schedule.

END OF SECTION

SECTION 084213

ALUMINUM ENTRANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum doors, frames and glazed lights.

B. Glass.

1.2 SYSTEM DESCRIPTION

A. System performance to provide for expansion and contraction within system components caused by temperature cycling.

B. Air and Water Leakage: Shall meet requirements of AAMA-HP.

C. Design and size members to withstand dead loads caused by pressure and suction of wind.

D. Drain water entering the framing system, to exterior.

1.3 SUBMITTALS

A. Shop Drawings: Indicate system and component dimensions; components within assembly; framed openings requirements and tolerances; anchorage and fasteners; glass and infills; door hardware requirements; and affected related work.

1.4 WARRANTY

A. Provide five (5) year warranty under provisions of Section 01001 including coverage for insulated glass units.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fabricators:
Doors: Kawneer: 500 Series or equal.
Framing Members: Kawneer Trifab II 451 or equal.

B. Extruded Aluminum: Aluminum alloy, 6063-T5.

C. Fasteners: Galvanized steel.

D. Sealant and Backing Materials: As specified in Section 079200.

2.2 FABRICATED COMPONENTS

A. Frames: See Drawings.

B. Reinforced Mullion: See Drawings.

C. Doors: See Drawings.

D. Infill Panels: See Drawings.

2.3 GLASS AND GLAZING MATERIALS

A. Glazing Materials: Exterior fixed gasket, system glazed at factory.
1" - 1/4 x 1/2 x 1/4 Low E.

2.4 HARDWARE - See Hardware Schedule – Specification Section 087100

2.5 FABRICATION

A. Fabricate doors and frames allowing for minimum clearances and shim spacing around perimeter of assembly.

B. Accurately and rigidly fit and secure joints and corners, flush, hairline, and weatherproof.

C. Arrange fasteners, attachments, and jointing to ensure concealment from view.

D. Prepare components with internal reinforcement for door hardware and door operator hinge hardware.

2.6 FINISHES

A. Exterior Aluminum Surfaces: Standard Color TBD

B. Interior Aluminum Surfaces: Standard Color TBD

Apply bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

A. Install doors, frames, glazing, and flashings in accordance with manufacturer's instructions AAMA - Window, Store Front and Entrance - Guide Specifications Manual.

B. Use anchorage devices to securely attach frame assembly to structure.

C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

D. Coordinate attachment and seal of air and vapor barrier materials. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

E. Install glass and panels in accordance with Section 088000, using exterior dry method of glazing.

F. Install perimeter type sealant, backing materials, and installation requirements in accordance with Section 079200.

3.3 TOLERANCES

A. Variation from Plane: 0.03 inches per foot maximum or 0.25 inches per 30 feet; whichever is less.

END OF SECTION

SECTION 085313

VINYL WINDOWS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vinyl windows.

B. Glass and framed insect screens.

C. Grilles

1.2 SYSTEM DESCRIPTION/QUALITY ASSURANCE

A. Window units are to meet the AAMA/NWWDA 101/I.S.2-97 standard. The standard was created by the American Architectural Manufacturers Association (AAMA) and the national Wood Window and Door Association (NWWDA). The minimum acceptable performance classification being H-C-50. Window units must have a maximum U value of .28 and an air infiltration rate of .3 CFM per sq. ft. of sash area. All operable windows are to be provided with full aluminum mesh screens.

B. Certification: All vinyl windows shall be delivered to the site bearing the certification label of conformance to AAMA Standards.

1.3 SUBMITTALS

A. Shop Drawings: Indicate dimensions, relation to construction of adjacent work, air and vapor seal with adjacent construction, component anchorage and locations, anchor methods, shim methods and materials, hardware, and installation details.

1.4 WARRANTY

A. Provide 25-year warranty under provisions of Section 01001 including coverage for insulated glass units. Five-year factory labor included.

PART 2 PRODUCTS

2.1 WINDOW UNITS

A. Window Unit Manufacturers: Equal to Paradigm Unitel Series 8382 Single Hung Window.

B. Window Configuration: Single and Twin, Single Hung, Fixed

C. Color: White or as noted on the Window Schedule.

2.2 FRAME MATERIALS AND ACCESSORIES

A. PVC Extrusions: .062" nominal wall thickness.

B. Sills: PVC - sloped for positive wash, one-piece full width of opening and jamb angles to

terminate sill length.

C. Insect Screen Frames: Rolled aluminum, of rectangular sections with aluminum mesh set into frame and secured. Fit frames with adjustable roller hardware.

D. Grilles: Contoured Grid – White or beige as selected by the Owner.

E. Weather Stripping: Foam type configured for flexible fit.

F. Sealant and Backing Materials: As specified in Section 079200.

G. Anchor Devices: Non-corroding.

2.3 GLASS AND GLAZING MATERIALS

A. Glass and Glazing Materials in Window Lights: Manufacturer's Argon Filled Insulated Low E Glass, except as noted on the Drawings or required by code.

2.4 HARDWARE

A. Single Hung Sash: Spiral friction slide cylinder, each sash, each jamb.

B. Sash lock: Lever handle with cam lock.

C. Insect Screen Frames: Rolled aluminum, of rectangular sections with aluminum mesh set into frame and secured. Fit frames with adjustable roller hardware.

2.5 FABRICATION

A. Fabricate framing, mullions and sash members to create a weather tight seal.

B. Form glass stops of extruded PVC to match cladding sloped for wash. Form weather stop flange to perimeter of unit.

C. Assemble insect screens of formed aluminum rectangular sections with aluminum mesh set into frame and secured. Fit frame with four spring loaded pin retainers.

D. Double weather-strip operable units.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that rough openings are correctly sized and located.

B. Prepare opening to permit correct installation of frame and achieve continuity of air and vapor barrier seal.

3.2 INSTALLATION

A. Install frames, glazing, hardware and flashings in accordance with manufacturer's instructions.

B. Use anchorage devices to securely attach frames to structure.

C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

D. Coordinate attachment and seal of air and vapor barrier materials. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

E. Install perimeter type sealant, backing materials, and installation requirements in accordance with Section 079200.

F. Clean windows.

3.3 Schedule – See Window Schedule

END OF SECTION

SECTION 087100

DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hardware for wood and hollow steel doors.

B. Thresholds and weatherstripping.

1.2 SUBMITTALS

A. Shop Drawings: Indicate locations and mounting heights of each type of hardware and electrical characteristics and connection requirements.

B. Operating and Maintenance Instructions: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

B. Hardware Supplier: Company specializing in supplying commercial door hardware with two years experience approved by manufacturer.

1.4 COORDINATION

A. Coordinate work of this section with other directly affected sections requiring any integral reinforcement for door hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually. Label and identify package with door opening code to match schedule.

B. Deliver keys to Owner by security shipment direct from hardware supplier.

1.6 MAINTENANCE

A. Provide manufacturer's maintenance services on door closers for one year from Date of Substantial Completion.

B. Provide special wrenches and tools applicable to each different or special hardware component.

PART 2 PRODUCTS

2.1 SUPPLIERS: Equal to those on the Hardware Schedule.

2.2 KEYING

A. Door Locks: Master keyed.

B. Supply 4 change keys for each lock and 8 master keys.

C. Key Cabinet: Sheet steel construction, enameled finish, hinged door with key lock, internal hooks for 300 keys, identification labeling. Aristocrat by Telkee.

2.3 FINISHES

A. Finishes to be US 26D or equivalent.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that doors and frames are ready to receive work and dimensions are as instructed by the manufacturer.

B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions.

B. Use templates provided by hardware item manufacturer.

END OF SECTION

SECTION 08705

DOOR HARDWARE – (MECHANICAL LOCKSETS)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hardware for wood and hollow steel doors.

B. Thresholds and weatherstripping.

1.2 SUBMITTALS

A. Shop Drawings: Indicate locations and mounting heights of each type of hardware and electrical characteristics and connection requirements.

B. Operating and Maintenance Instructions: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

B. Hardware Supplier: Company specializing in supplying commercial door hardware with two years experience approved by manufacturer.

1.4 COORDINATION

A. Coordinate work of this section with other directly affected sections requiring any integral reinforcement for door hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually. Label and identify package with door opening code to match schedule.

B. Deliver keys to Owner by security shipment direct from hardware supplier.

1.6 MAINTENANCE

A. Provide manufacturer's maintenance services on door closers for one year from Date of Substantial Completion.

B. Provide special wrenches and tools applicable to each different or special hardware component.

PART 2 PRODUCTS

2.1 SUPPLIERS: Equal to those on the Hardware Schedule.

2.2 KEYING

A. Door Locks: Master keyed.

B. Supply 4 change keys for each lock and 8 master keys.

C. Key Cabinet: Sheet steel construction, enameled finish, hinged door with key lock, internal hooks for 300 keys, identification labeling. Aristocrat by Telkee.

2.3 FINISHES

A. Finishes are identified in Schedule at end of this Section.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that doors and frames are ready to receive work and dimensions are as instructed by the manufacturer.

B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions.

B. Use templates provided by hardware item manufacturer.

3.3 SCHEDULE

A. Set 1

Bedroom Door Type A (Bedroom Entrance Door)
Bedroom Nos.: 101-118, 201-222
Each Doorway to have:
Hinge: (3) Stanley FBB179 4 ½ x 4 ½ US26D
Closer: Norton 850/BRALUM
Lockset: Schlage Jupiter L9453
Stop: Stanley CD7090 US26D
Peep Hole: Baldwin No. 0155
Silencers: (3) Ives No. 20

B. Set 2

Apartment Door Type B (Bathrooms)
Apartment Nos: 101-118 & 201-222
Each Doorway to have:
Hinges: (3) Stanley FBB 179 4 ½ x 4 ½ US26D
Lockset: Schlage Jazz F40N (Privacy Set) US26D

Stop: Ives 069 US26D
Silencers: Ives 581 US26D

C. Set 3

Bedroom Door Types C (Sliding Closet Doors)
Bedroom Nos.: 101,108,109.110,117,118,201,209,210,213,221,222
Each Doorway to have:
Sliding Door Hardware: Stanley 405665
Sliding Door Pulls: (2) Ives No. 22 – US26D

D. Set 4

Apartment Door Type D (Bedroom)
Apartment Nos.: 101-118, 201-222
Each Doorway to have:
Hinges: (3) Stanley F179 3 ½ x 3 ½ US26D
Lockset: Schlage Jazz F40N (Privacy Set) US26D
Stop: Ives 069 US26D

E. Set 5

Door Nos.: B01,B20,106,148
Each Doorway to have:
Hinges: Door Manufacturer's Standard
Exit Device: Von Duprin 88L-07 US26D
Closer: Norton 8501 BF ALUM
Weatherstripping: Door Manufacturer's Standard
Sweep: Door Manufacturer's Standard
Threshold: Door Manufacturer's Standard

F. Set 6

Door Nos.: B02,B03,B04,B13,B15,102,103,104,143,146,202,203,204,205,226,227,228,230
Each Doorway to have:
Hinges: Door Manufacturer's Standard
Lockset: Schlage Jupiter AL80 PD US26D (Storeroom Function)
Closer: Norton 8501 BF ALUM with backcheck
Stop: Baldwin 4028 US26D

G. Set 7

Door No.: B05
Each Doorway to have:
Hinges: (6) Stanley FBB179 4 ½ x 4 ½ US26D
Lockset: Schlage Jupiter AL 80 PD US26D (Storeroom Function)
Flush Bolt: Ives FB32 US26D
Closer: Norton 8501 BF ALUM with backcheck
Silencers: (6) Ives No. 20 Rubber

H. Set 8

Door Nos.: B06, B12
Each Doorway to have:
Hinges: (6) Stanley FBB179 4 ½ x 4 ½ US26D
Exit Divice: (2) Von Duprin 8827L-07 US26D
Closer: (2) Norton 8501 BF ALUM
Weatherstripping: Pemko 303 AV

Sweep: Pemko 315 SNN
Threshold: Pemko 253 X 3 AFG
Silencers: (3) Ives No. 20 Rubber

I. Set 9

Door Nos.: B07,B10,B10A,B16,108,124,125,126,208,210,211,212,215,219,222
Each Doorway to have:
Hinges: (3) Stanley F179 4 ½ x 4 ½ US26D
Lockset: Schlage Jupiter AL70 PD US26D (Classroom Function)
Closer: Norton 8501 BF ALUM with backcheck
Stop: Baldwin 4028 US26D
Silencers: (3) Ives No. 20 Rubber

J. Set 10

Door Nos.: B08,114,127,128,129,132,217
Each Doorway to have:
Hinges: (3) Stanley FBB179 4 ½ x 4 ½ US26D
Lockset: Schlage Jupiter AL 50 PD US26D (Office Function)
Stop: Ives WS406 CCV US26D
Silencers: (6) Ives No. 20 Rubber

K. Set 11

Door Nos.: B11,138,139,220,221,229
Each Doorway to have:
Hinges: (3) Stanley F179 4 ½ x 4 ½ US26D
Lockset: Schlage L9486XL583-370-07 Lever – US26D (Privacy Function with Occupancy Indicator)
Closer: Norton 8501 BF ALUM
Stop: Ives WS102 CXV US26D
Hook: Ives 581 US26D
Silencers: (3) Ives No. 20

L. Set 12

Door No.: B14
Each Doorway to have:
Hinges: (3) Stanley F179 4 ½ x 4 ½ US26D
Lockset: Schlage Jupiter AL80 PD US26D (Storeroom Function)
Closer: Norton 8501 BF ALUM with backcheck
Stop: Baldwin 4028 US26D
Silencers: (3) Ives No. 20 Rubber

M. Set 13

Door Nos.: B17,B18,131,214
Each Doorway to have:
Hinges: (3) Stanley F179 4 ½ x 4 ½ US26D
Lockset: Schlage L9486XL583-370-07 Lever – US26D (Privacy Function with Occupancy Indicator)
Stop: Baldwin 4276 US26D
Hook: Baldwin 0783 US26D
Silencers: (3) Ives No. 20

N. Set 14

Door No.: B19
Each Doorway to have:
Hinges: Door Manufacturer's Standard
Lockset: Schlage Jupiter AI 70 PD US26D (Classroom Function)
Closer: Norton 8501 BF ALUM
Weatherstripping: Door Manufacturer's Standard
Threshold: Handicap Type – by Door Manufacturer

O. Set 15

Door Nos.: 101,105,140,142,147,201,206,222,225,231
Each Doorway to have:
Hinges: (3) Stanley FBB179 4 ½ x 4 ½ US26D
Exit Device: Von Dunprin 88L-07-US26D
Closer: Norton 8501 BF ALUM with backcheck
Silencers: (6) Ives No. 20 Rubber
Stop: Baldwin 4028 US26D

P. Set 16

Door Nos.: 107,141,207,224
Each Doorway to have:
Hinges: (6) Stanley F179 4 ½ x 4 ½ US3
Exit Device: (2) Von Duprin 8827L-07 Lever – US26D
Closer: (2) Norton 8501 BF GB
Stop: Baldwin 4028 US3
Mag Hold: By FA Contractor

Q. Set 17

Door Nos. 109,113,115,116,121,122,130,135,136,209
Each Doorway to have:
Hinges: (3) Stanley 179 4 ½ x 4 ½ US26D
Lockset: Schlage Jupiter AL70 PD US26D (Classroom Function)
Stop: Baldwin 4028 US26D
Silencers: (3) Ives No. 20 Rubber

R. Set 18

Door Nos.: 110,123
Each Doorway to have:
Hinges: (6) Stanley F179 4 ½ x 4 ½ US3
Exit Device: (2) Von Duprin 8827L-07 Lever – US26D (Classroom Function)
Closer: (2) Norton 8501 BF GB
Stop: Baldwin 4028 US3
Mag Hold: By FA Contractor

S. Set 19

Door Nos.: 111,112
Each Doorway to have:
Hinges: (3) Stanley FBB179 4 ½ x 4 ½ US26D
Deadbolt: Schlage B 460P with thumb turn US26D
Pull Plate: Baldwin 2365 US26D
Push Plate: (1) Baldwin 2103 US26D
Closer: Norton 8501 BF AL with holdopen

Silencers: (3) Ives No. 20

T. Set 20

Door Nos.: 117,119,120
Each Doorway to have:
Hinges: Manufacturer's Standard Offset Pivot - #14 Clear Anodized
Exit Device: (2) Von Duprin 88L-07 US26D (Classroom Function)
Closer: Norton 8501 BF AL with backcheck
Weatherstripping: Manufacturer's Standard
Sweep: Manufacturer's Standard
Threshold: Manufacturer's Standard

U. Set 21

Door No.: 118
Each Doorway to have:
Hinges: Manufacturer's Standard Offset Pivot - #14 Clear Anodized
Push Bar: Manufacturer's Standard
Pull Bar: Manufacturer's Standard
Closer: Norton 8501 BF AL with backcheck

V. Set 22

Door Nos.: 133,134,137,144,145
Each Doorway to have:
Hinges: (3) Stanley FBB179 4 ½ x 4 ½ US26D
Lockset: Schlage Jupiter AL 50 PD US26D (Office Function)
Closer: Nort6on 8501 BF ALUM with backcheck
Silencers: (3) Ives No. 20 Rubber

END OF SECTION

SECTION 088000

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Glass and glazing for Sections referencing this Section for Products and installation.

1.2 SYSTEM DESCRIPTION

A. Glass and glazing materials of this Section shall provide continuity of building enclosure vapor and air barrier.

B. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass.

1.3 SUBMITTALS

A. Product Data on Glass Types Specified: Provide physical and environmental characteristics, size limitations, and special installation requirements.

B. Product Data on Glazing Compounds: Provide chemical characteristics, limitations, special application requirements. Identify available colors.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with FGMA Glazing Manual, FGMA Sealant Manual for glazing installation methods.

1.5 WARRANTY

A. Provide five(5) year warranty under provisions of Section 010001 including coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 PRODUCTS

2.1 FLAT GLASS MATERIALS

A. Manufacturers:
   1. Libby-Owens Ford Co.
   2. PPG Industries, Inc.
   3. Guardian Industries, Inc.

B. Float Glass: Clear, 1/4 inch thick.

C. Safety Glass: Clear; fully tempered; conforming to ANSI Z97.1; 1/4 inch thick minimum.
D. Fire Rated Glass: Clear, Fire Rated, Safety Rated Glass Ceramic Equal to Fire Lite Plus Manufactured By: Technical Glass Products. 5/16 inch thick.

E. Mirror Glass: Clear float type with copper and silver coating, organic overcoating, beveled edges, 1/4 inch thick minimum. See Bathroom Details for mirror sizes.

2.2 SEALED INSULATING GLASS MATERIALS

A. Manufacturers:
1. Libby-Owens Ford Co.
2. PPG Industries, Inc.
3. Guardian Industries, Inc.

B. Insulated Glass Units: Double pane with silicone sealant edge seal; outer pane of heat strengthened or tempered glass, inner pane of heat strengthened or tempered glass; total unit thickness of 5/8 to 1 inch.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that openings for glazing are correctly sized, within tolerance, and glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

3.2 EXTERIOR - DRY METHOD (PREFORMED GLAZING)

A. Cut glazing tape to length; install on glazing pane. Seal corners with butyl sealant.

B. Place setting blocks at 1/4 points.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.

E. Trim protruding tape edge.

3.3 INTERIOR

A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.

D. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.

E. Fill gaps between pane and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.

F. Trim protruding tape edge.

3.4 INSTALLATION – MIRRORS

A. Set mirrors with clips. Anchor rigidly to wall construction.

B. Place plumb and level.

3.5 INSTALLATION – FIRE RATED GLASS

A. Install Fire Rated Safety Glass in accordance with the Manufacturer's Requirements.

B. Place plumb and level.

3.6 CLEANING

A. Remove glazing materials from finish surfaces.

B. Remove labels after Work is complete.

C. Clean glass and mirrors.

3.7 SCHEDULE - See Door Schedule and Interior Elevations.

END OF SECTION

SECTION 092900
GYPSUM BOARD SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

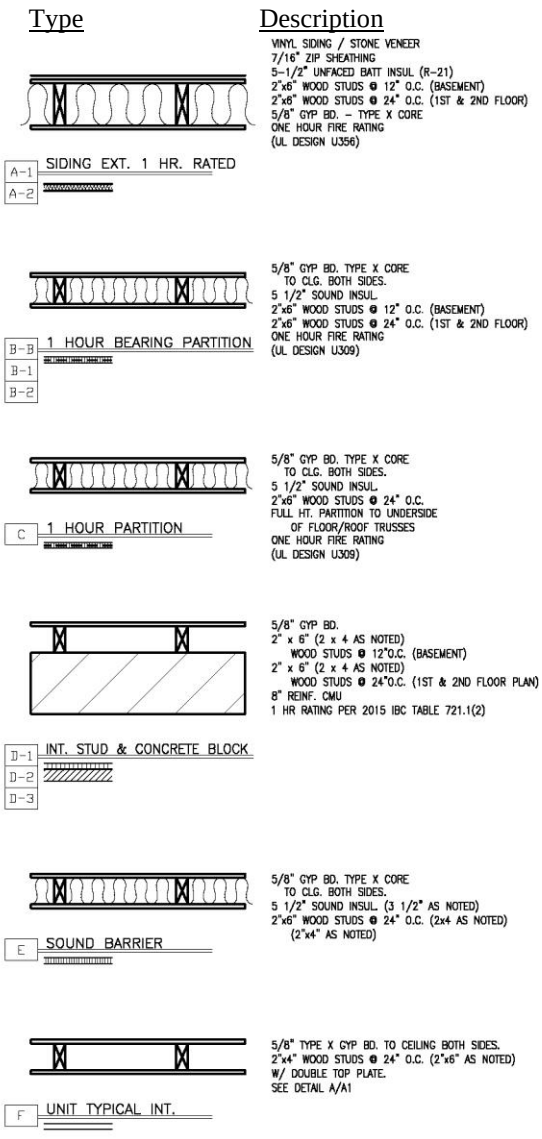
A. Acoustic insulation.

B. Gypsum board with taped and sanded joint treatment.

1.2 SYSTEM DESCRIPTION

A. Acoustic Attenuation for Identified Interior Partitions: 50 STC in accordance with ASTM E90.

B. Conform to applicable code for fire rated assemblies as follows:
1. Partition and Wall Systems



Note: All bathrooms, laundry rooms, and other wet areas to receive 5/8" moisture resistant Gypsum Board.

2. Floor/Ceiling and Ceiling/Roof Assembly Types

Type 1. Assembly at Wood Trusses (1 hr Rating UL Design L528): 5/8" Gypsum Board F.C. Type C applied at right angles to resilient furring channel with 1" Type S drywall screws 12" oc and 1-1/2" from edges and joints located mid-way between continuous channels 16" oc secured with1 ¼ long No.6 Type S Bugle Head screws to parallel chord wood trusses 24" oc supporting 3/4" nominal floor sheathing with exterior glue, T&G edges, perpendicular to trusses, joints staggered 4' with construction adhesive and No. 6d ring shank nails 12" oc. Adhesive applied to each top chord and grooved edges of plywood. 6" sound attenuating insulation.

Type 2. Assembly at Wood Joists (1 hr Rating UL Design L501): 5/8" Type X Gypsum Board ceiling, 3/4" floor sheathing with exterior glue screwed and glue to 2x joists, 6" sound attenuating insulation between joists.

Type 3. Suspended Gypsum Board Ceiling (Not-Rated): 5/8" Gypsum Board applied to drywall suspended grid system equal to Armstrong Sl8945.6" sound attenuating insulation.

Type 4. Ceiling Roof Assembly (1 hr Rating – UL Design P533) Gypsum Board, Wood Joists, Roof Covering: One Layer 5/8" Type C gypsum wallboard applied at right angles to resilient furring channels 12" OC with 1 1/8" Type S drywall screws 8" OC. Gypsum board end joints attached with screws 8" OC to additional pieces of channel 60" long located 3" back on either side of end joint. Resilient channels applied at right angles to bottom chord of wood roof trusses 24" OC with 1 ¼" Type S or W screws. Glass fiber or mineral fiber with kraft paper facing applied directly over gypsum board. Trusses supporting 15/32" plywood or OSB roof sheathing applied at right angles to trusses with construction adhesive and 6d ring shank nails 12" OC.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C840, GA-600 - Fire Resistance Design Manual.

PART 2 PRODUCTS

2.1 GYPSUM BOARD SYSTEM

A. Manufacturers:
1. U.S. Gypsum Co.
2. Domtar Gypsum
3. Gold Bond Gypsum

B. Gypsum Board Types: See Sections 1.2.1, 1.2.2, and 1.2.3. All Gypsum Board to be maximum permissible length; ends square cut, tapered edges; unless noted otherwise as follows:
1. Standard Type: ASTM C36.
2. Fire Rated Type: ASTM C36 fire resistive, UL rated.
3. Moisture Resistant Type: ASTM C630.

4. Gypsum Sheathing: ASTM C79

2.2 ACCESSORIES

A. Sound Insulation: ASTM C665, preformed mineral wool, friction fit type, thickness as indicated.

B. Acoustical Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board; manufactured by U. S. Gypsum Co., or equal.

C. Corner Beads: Metal.

D. Edge Trim: GA 201 and GA 216, Type LC L bead U shape exposed reveal bead.

E. Joint Materials: GA 201 and GA 216, reinforcing tape, joint compound, adhesive, and water.

F. Fasteners: ASTM C1002 Type S12 hardened screws.

G. Drywall Suspended Grid System: Equal to Armstrong Drywall Grid System

H. Ceiling Furring – ASTM C645, 7/8" Resilient Furring Channels

I. Soffit Framing: 1 5/8" Light Gauge Metal Studs – Marino or Equal

J. "Z" Furring Channels – US Gypsum or Equal

PART 3 EXECUTION

3.1 INSTALLATION – SOFFIT FRAMING

A. Install studding in accordance with ASTM C754.

B. Metal Stud Spacing: 16 inches o.c. – See Partition Types on Drawings.

C. Partition Heights: As indicated on dwgs. Install additional bracing for partitions extending above ceiling.

3.2 INSTALLATION – CEILING FRAMING

A. Install in accordance with ASTM C754.

B. Coordinate location of hangers with other work. Install ceiling framing independent of walls, columns, and above ceiling work.

C. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing.

D. Laterally brace entire suspension system.

3.3 INSTALLATION – ACOUSTICAL ACCESSORIES

A. Install resilient channels at maximum 24 inches on center. Locate joints over framing members.

B. Place acoustical insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

C. Install acoustical sealant within partitions in accordance with manufacturer's instructions.

3.4 INSTALLATION - GYPSUM BOARD

A. Install gypsum board in accordance with manufacturer's instructions.

B. Fasten gypsum board to furring or framing with screws.

C. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

D. Treat cut edges and holes in moisture resistant gypsum board, with sealant.

3.5 JOINT TREATMENT

A. Tape, fill & sand exposed joints, edges & corners to produce smooth surface ready to receive finishes.

B. Feather coats onto adjoining surfaces so that camber is maximum 1/32 inch.

C. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.

D. Erect pre-decorated gypsum board vertically, with exposed batten fastening system.

E. Erect in accordance with manufacturer's instructions.

3.6 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 095113

SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Acoustical tile.

1.2 SYSTEM DESCRIPTION

A. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.

B. Conform to applicable code for combustibility requirements for materials.

PART 2 PRODUCTS

2.1 SUSPENSION SYSTEM – TYPE A

A. Manufacturers: Armstrong; Prelude 15/16" Exposed Tee Grid – Type A Ceiling

B. Grid: ASTM C635, intermediate duty, non-fire rated, exposed T configuration; components die cut and interlocking.

C. Accessories: Stabilizer bars, clips, splices, edge moldings as required for suspended grid system.

D. Grid Materials:
1. Prelude Commercial quality cold rolled steel with galvanized coating.
2. Al Prelude Plus XL: Commercial Quality Aluminum

E. Grid Finish: White.

F. Support Channels and Hangers: Galvanized steel, size and type to suit application.

2.2 ACOUSTICAL UNITS – TYPE A

A. Manufacturers:
Armstrong Dune No. 1774

B. Acoustical Tiles: Conforming to the following:
1. Size: 24 x 24 inches.
2. Thickness: 5/8 inches.
3. Surface Finish: Non-directional fissured.
4. Edge: Angled Tegular Lay-In
5. Grid: Armstrong Prelude 15/16" exposed tee grid

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - SUSPENSION SYSTEM

A. Install system in accordance with manufacturer's instructions.

B. Coordinate the location of hangers with other work. Where components prevent the regular spacing of hangers, reinforce the system to span the extra distance.

C. Hang system independent of walls, columns, ducts, pipes and conduit.

D. Locate system according to reflected plan.

E. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths.

F. Install grid so that no tiles are less than 1/2 width.

3.3 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units level, free from damage, twist, warp or dents.

3.4 TOLERANCES

A. Variation from Flat and Level Surface: 1/8 inch in 10 feet.

END OF SECTION

SECTION 096500

RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient Sheet Flooring (SV-1)

B. Luxury Vinyl Tile (LVT)

C. Vinyl Composition Tile (VCT)

D. Vinyl Base

E. Stair Treads and Nosing

1.2 SYSTEM DESCRIPTION

A. Floor Materials: Conform to applicable code for flame/smoke rating requirements in accordance with ASTM E84.

PART 2 PRODUCTS

2.1 SHEET VINYL AND VINYL COMPOSITION TILE MATERIALS

A. Sheet Vinyl (SV-1) – ASTM E648 and 662, color and pattern through total thickness:
1. Sheet Width: 79 inches
2. Manufacturers: Equal to Forbo Eternal Material

B. Luxury Vinyl Tile (LVT) – ASTM E648 and 662, color and pattern through total thickness:
1. Tile Size: Manufacturers Standard
2. Manufacturers: Equal to Forbo Allura Wood LVT HQ

C. Vinyl Composition Tile: (VCT) ASTM F1066:
1. Size: 12 x 12 inch
2. Thickness: 1/8 inch
3. Design: marbleized
4. Manufacturers: a) Armstrong Style Standard Excelon
b) Tarkett Basic or Expressions
c) Azrock – Vinyl Composition Tile

2.2 BASE MATERIALS

A. Base: FS SS-W-40, Vinyl; top set coved toe at resilient flooring, toeless at carpeting; premolded external corners:

1. Height: 4 inch in all areas except lavatories, bathrooms, and laundry room where 6 inch high base is required

Thickness: .080 gauge

2. Manufacturers:
   a) Armstrong Style Standard Vinyl Base
   b) Tarkett Standard Cove Base
   c) Roppe Vinyl Cove Base
   d) Johnsonite Vinyl Base

B. Base Accessories: Premolded end stops & external corners, of same material, size & color as base.

2.3 STAIR TREADS AND RISERS

A. Stair Treads and Risers: ASTM E648; full width and depth of stair tread in one piece; Full width and height of Stair Riser in one piece suitable for installation over Wood Treads and Risers.

Material:	Rubber
Thickness:	1/8 Inch
Pattern:	Heavy Duty Diamond Tread – Round Nose
Manufacturers:	Johnsonite or Equal

2.4 ACCESSORIES

A. Subfloor Filler: Type recommended by floor material manufacturer.

B. Adhesives
1. All adhesives used for installation of flooring material shall be those recommended by the flooring manufacturer to suit the grade level, subfloor conditions and usage conditions.
2. All adhesives shall be low VOC or no VOC rated
3. Adhesive Wet Areas
   The following rooms are to considered WET AREAS: Bathrooms, Lavatories, Mechanical Rooms, Laundry and Janitor's Closets. An adhesive rated for wet area installation shall be utilized.

C. Vinyl Composition Tile (VCT) – Waterproof, Type recommended by floor material manufacturer. (Low VOC)

D. Edge Strips: Vinyl Snap in type equal to Roppe #152 Snap Down Divider with #178 Flexi-Track. Color to be selected by the Architect.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify wood floor underlayment type and installation are in accordance with the manufacturers recommendations for the specific flooring type that is being installed.

B. Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization, or dusting.

C. Fill minor or local low spots and other defects with subfloor filler.

D. Vacuum Clean Substrate

3.2 INSTALLATION - SHEET MATERIAL

A. Install in accordance with manufacturer's instructions.

B. Spread adhesive and set flooring in place. Press with heavy roller to attain full adhesion.

C. All sheet flooring seams in kitchen, restrooms, bathrooms and laundry to be heat welded. (Note: SV Installation to be seamless)

D. Tile Flooring
Install tile flooring with joints and seams parallel to building lines. Allow minimum 1/2 full size tile width at room or area perimeter.

E. Terminate flooring at centerline of closed door at openings where adjacent floor finish is dissimilar. Install edge strips where flooring terminates.

F. Scribe flooring to appurtenances to produce tight joints.

3.3 INSTALLATION - BASE MATERIAL

A. Adhere base tight to wall and floor surfaces.

B. Fit joints tight and vertical. Miter internal corners. At external corners, V cut back of base strip to 2/3 of its thickness and fold.

3.4 INSTALLATION – RUBBER TREADS AND RISERS

A. Install in accordance with the manufacturers instructions.

B. Adhere materials tight to wall at stair surfaces.

3.5 CLEANING

A. Vinyl Composition Tile – Clean, strip, seal and wax surfaces in accordance with manufacturers instructions.

B. Remove excess adhesive from surfaces without damage.
LVT Flooring – wash and dry buff as recommended by the manufacturer.

C. Clean and Finish all other Resilient Flooring in accordance with the manufacturers requirements.

END OF SECTION

SECTION 096816

CARPET

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Carpet

B. Entrance Mat

1.2 SYSTEM DESCRIPTION

A. Carpet Materials: Conform to applicable code for flame/smoke rating requirements in accordance with ASTM E84.

B. HUD Requirements: Carpet shall comply with HUD Use of Materials Bulletin No. 44d, including the labeling requirements. Type II Class 2 carpeting shall be used in all areas to receive carpeting.

C. Green Label – All carpeting shall be Green Labeled

1.3 SUBMITTALS

A. Samples: Submit two samples 18 x 18 inch in size illustrating color and pattern for each carpet material specified.

1.4 MAINTENANCE

A. Provide one (1) roll width by 50' length of each carpeting of each color selected.

PART 2 PRODUCTS

2.1 CARPET MATERIALS

A. CPT-1: Sleeping Rooms

1.	Carpet Construction:	Textured
2.	Manufacturer:	Shaw Carpets
3.	Pile fiber:	Nylon
4.	Style:	Shaw Carpets, Ultimate Yield
5.	Color:	00731 Falcon Wing
6.	Pile face weight:	Minimum 25 ounces per square yard
7.	Dye method:	Solution Dyed
8.	Installation Method:	Direct Glue
9.	Transition strips:	Brushed Chrome

B. CPT-2: Common Areas & Stairs

1.	Rating:	Class A.
2.	Pile Fiber:	Nylon

3.	Manufacturer:	Shaw Philadelphia
4.	Style:	Level loop "Camden Harbor", color to be determined
5.	Carpet Accent/Border:	Philadelphia, "Empathic", color to be determined
6.	Backing:	Polypropylene
7.	Pile Face Weight:	Minimum 28 ounces per square yard
8.	Die Method:	Solution
9.	Installation Method:	Direct Glue Down over concrete or underlayment

C. Entrance Mats, Elevator Carpeting - Equal to the following criteria:

1.	Manufacturer:	Van Dijk Carpet
2.	Style:	Hercules – Needlepunch Texture
3.	Color:	Selection by the Architect
4.	Installation:	Lay-In, Glue Down

2.2 ACCESSORIES

A. Subfloor Filler: Type recommended by carpet manufacturer.

B. Adhesive: Latex adhesive for direct gluedown installation.

C. Carpet Gripper: Type recommended by carpet manufacturer to suit application, with attachment devices.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that substrate surfaces are smooth and flat with maximum variation in 1/4 inch in 10 ft are ready to receive work.

B. Fill minor or local low spots and other defects with subfloor filler.

C. Vacuum floor surfaces.

3.2 INSTALLATION – CARPET ADHESIVE APPLIED

A. Apply carpet and adhesive in accordance with manufacturers' instructions.

B. Verify carpet match before cutting to ensure minimal variation between dye lots.

C. Double cut carpet, to allow intended seam and pattern match. Make cuts straight, true, and unfrayed. Edge seam carpet at public areas.

D. Locate seams in area of least traffic.

E. Join seams by hot adhesive tape method. Form seams straight, not overlapped or peaked, and free of gaps.

F. Lay carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance. Provide monolithic color, pattern, and texture match within any one area.

G. Do not change run of pile in any room where carpet is continuous through a wall opening into another room. Locate change of color or pattern between rooms under door centerline.

H. Cut and fit carpet around interruptions.

I. Fit carpet tight to intersection with vertical surfaces without gaps.

J. Install carpet continuously to stair treads and risers, full width. Install in one piece. Adhere over entire surface. Fit accurately and securely, tight to treads and risers. Adhere carpet on treads and risers and butt tight to nosing.

3.4 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 099000

PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation and field application of paints and coatings.

1.2 SYSTEM DESCRIPTION

A. Finish Materials: Conform to applicable code for flame/smoke rating requirements.

1.3 SUBMITTALS

A. Product Data: Provide data on all finishing products.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Store and apply materials in environmental conditions required by manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manufacturers:
   1. Pratt and Lambert, Inc.
   2. Benjamin Moore Company.
   3. The Glidden Company.
   4. The Sherwin-Williams Company

B. All paint shall be low VOC or no VOC rated

C. Material quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

D. Coatings: Ready mixed except field catalyzed coatings of good flow and brushing properties, capable of drying or curing free of streaks or sags.

E. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials required to achieve the finishes specified.

2.2 FINISHES

A. Refer to finish schedule on Drawing Sheet A10.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that substrate conditions are ready to receive work.

B. Measure moisture content of porous surfaces using an electronic moisture meter. Do not apply finishes unless moisture content is less than 12 percent.

C. Correct minor defects and clean surfaces which affect work of this Section.

D. Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

E. Gypsum Board Surfaces: Fill minor defects w/ latex compounds. Spot prime defects after repair.

F. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

G. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove foreign matter. Remove oil and grease with a solution of tri-sodium phosphate, rinse well and allow to dry.

H. Uncoated Ferrous Surfaces: Remove scale by wire brushing, sandblasting, clean by washing with solvent. Apply treatment of phosphoric acid solution. Prime paint after repairs.

I. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust, clean surfaces with solvent. Prime bare steel surfaces.

J. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

K. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.

L. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.

M. Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.

3.2 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Sand transparent finishes lightly between coats to achieve required finish.

C. Where clear finishes are required, tint fillers to match wood.

D. Back prime interior and exterior wood work scheduled to receive paint finish with primer paint.

E. Back prime interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

3.3 CLEANING

A. As work proceeds, promptly remove finishes where spilled, splashed, or spattered.

3.4 SCHEDULE - EXTERIOR SURFACES

A. Wood and PVC Trim Pieces - Painted (Opaque):
1. One coat of acrylic latex primer sealer.
2. Two coats of acrylic latex satin finish.

B. Wood - Transparent:
1. One coat of stain.
2. Two coats of sealer.

C. Steel - Shop Primed:
1. Touch-up with alkyd primer.
2. Two coats of latex semi-gloss.

D. Steel - Galvanized:
1. One coat of galvanize primer.
2. Two coats of latex semi-gloss.

3.5 SCHEDULE - INTERIOR SURFACES

A. Wood - Painted:
1. One coat of latex primer sealer.
2. Two coats of latex enamel, semi-gloss.

B. Wood - Transparent:
1. Filler coat for open grained wood only.
2. Two coats of stain.
3. One coat of sealer.
4. Two coats of polyurethane satin.

C. Concrete, Concrete Block:
1. One coat of primer sealer alkyd.
2. Two coats of latex, flat.

D. Steel - Unprimed:
1. One coat of alkyd primer.
2. Two coats of latex enamel, semi-gloss.

E. Steel - Primed:
1. Touch-up with original primer.
2. Two coats of latex enamel, semi-gloss.

F. Steel - Galvanized:
1. One coat of galvanize primer.
2. Two coats of latex enamel, semi-gloss.

G. Plaster, Gypsum Board:
1. Provide one coat LATEX Primer Sealer and two (2) coats Flat Latex Paint to all interior walls and ceilings except in bathrooms, kitchens, and public spaces where one coat LATEX primer and Two (2) coats scrub able eggshell latex paint shall be used.
2. Public corridors and rooms receiving a chair rail shall be painted two colors – one below the chair rail and another above the chair rail.

3.8 SCHEDULE - COLORS - As Selected by the Architect

END OF SECTION

SECTION 101005

MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closet Shelving and Storage System

B. Fire Extinguisher Cabinets – Fire Rated

C. Fire Extinguishers

D. Cabinets

E. Quartz Countertops

F. Vanity Countertops

G. Corner Guards

H. Access Panels

I. Stair Handrails

J. Signage

K. FRP Wainscot Panel

L. Corridor Handrails

1.2 SYSTEM DESCRIPTION

A. Provide all materials to complete the following as indicated or implied in the Drawings and Specifications. Installation of all materials noted in this Section will be by the Finish Carpentry Contractor.

1.3 SUBMITTALS

A. Shop Drawings: Indicate component locations, dimensions, details of blocking and attachment, and anchors.

B. Product Data: Provide data on product, accessories, and method of attachment.

C. Operating and Maintenance Instructions: Include relevant instructions.

D. Submit manufacturer's installation instructions.

E. Include maintenance information on regular cleaning and stain removal.

1.4 QUALITY ASSURANCE

A. Perform all work in accordance with manufacturer's recommendations.

B. Fire Extinguisher: Conform to NFPA 10.

PART 2 PRODUCTS

2.1 CLOSET SHELVING AND STORAGE SYSTEM

A. Manufacturer:
Closet Maid
Lee/Rowan
Stanley

B. Product: Vinyl clad wire shelving and mounting accessories.
Description
Pole & Shelf – 12" Deep, Normal Mesh
Shelving Only – 16" Deep, Fine Mesh
Linen Closet Shelving – 12" Deep, Normal Mesh

2.2 FIRE EXTINGUISHER CABINETS

A. Manufacturer – Equal to: Larsens; Model FS 2409-6R.

B. Product: White baked enamel fire rated steel cabinet with horizontal duo door.

C. Quality: Provide Twelve (12) Fire Extinguisher Cabinets.

D. Locations: As indicated on the floor plans.

2.3 FIRE EXTINGUISHERS

A. Manufacturer: Larsens; Model MP10 or equal.
J.L. Industries; Cosmic 10E

B. Dry Chemical Type: Steel tank, with pressure gage 4A-60B:C; Model MP10 manufactured by Larsens.

C. Quality: Provide Twelve (12) Fire Extinguishers

D. Locations: As indicated on the floor plans.

2.4 CABINETS

A. Manufacturer equal to Merillat Classic Series Cabinets – Portrait w/Solid Drawer Front painted finish.

B. Product: Base and wall cabinets as indicated on the Drawings with all accessories required for a complete installation.

C. Cabinet Description:
Frames: All frames are built of solid 3/4" hard wood, kiln-dried rails, joined by mortise and tenon

w/glue.
End Panels: 1/2" hardwood veneer plywood fastened to front frame with full 1/2" tongue and groove, recessed 1/8" from edge.
Backs: 1/8" hardboard, recessed in sides.
Bottoms: 3/16" hardwood, dadoed into sides and power nailed into supporting strips.
Mounting Strips: 3/4" x 1-1/2", located at top.
Corners: Wood blocks glued and power nailed.
Toe Kick: 3/4" x 3-1/2" pine.
Shelf: 1/2" plywood core 11" deep dadoed into sides, with a wood grain-printed wrap and rounded front edge.
Doors – Solid Hardwood Door Frame with recessed flat panel.
Hardware: Self-closing hinges, which are interlocking and self-adjusting. 4" Wire Pulls on all drawers and doors (US 260 Finish). Submit sample to Architect for approval.
Finish: Paint finish factory applied.
Color: As selected by the Architect.

D. Certification: All kitchen cabinets shall be delivered to the site bearing the certification label of conformance to the Kitchen Cabinet Manufacturers Association Standards. ANSI/KCMA A161-1.

2.5 QUARTZ COUNTERTOPS

A. Manufacturer equal to: Cambria Quartz Surfaces

B. Product: Quartz Countertops and 4" Backsplash, 2 cm thick, standard color as selected by the Architect.

2.6 VANITY TOPS

A. Manufacturer equal to: RYNONE – 30 Series

B. Product: Cultured Marble top with integral center bowl, size as indicated on the drawings, standard color as selected by the Architect.

2.7 ACCESS PANEL

A. Manufacturer equal to: Bar-Co Fire Rated Access Door.
Cesco Type FB.
Karp - KRP - 150FR.

B. Fire Rated: Quantity (2) Access Panels 22" x 30" – 60 minute rating

C. Non Rated Panels: 24" x 24" non rated access panels in each apartment to access ERV unit. Verify specific location with HVAC contractor.

2.8 STAIR HANDRAIL

A. Bracket Manufacturer: Stanley CD80-4100
EconoRail - Cast brass 1-1/2" round
J.G. Braun Co - No. 4402

B. Product: 1-1/2" diameter oak handrail, mounting brackets 48" o.c. with ends returning to the wall. Polyurethane finish – See Section 09900.

2.9 INTERIOR SIGNAGE

A. Manufacturer equal to Mohawk Sign Systems Inc.

B. Product: Standard ADA Signs - Mohawk Series 200 A Type B Format.

C. ADA Requirements: All standard signage shall conform to all ADA requirements. All sign lettering to be in Braille as well as normal lettering.

2.10 FRP PANEL – KITCHEN AREA

A. Manufacturer: Kemlite Fire-X Glassboard.

B. Product: Fiberglass reinforced plastic panels (Class A Fire Rated) and all required moldings, adhesive, etc. for a complete installation. Color to be selected by the Architect.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that surfaces and internal wall blocking are ready to receive work and opening dimensions are as indicated on shop drawings.

3.2 INSTALLATION - CLOSET SHELVES AND POLE SYSTEM

A. Install shelving in accordance with manufacturer's instructions. Shelving mounting brackets to be attached to wood blocking or wood studs. Finish screws are to be used to attach brackets to wall.

B. Secure units level and plumb.

3.3 INSTALLATION - FIRE EXTINGUISHER CABINETS

A. Install cabinets in accordance with manufacturer's instructions at locations determined by the Architect.

B. Secure units level and plumb.

3.4 INSTALLATION - FIRE EXTINGUISHERS

A. Install extinguishers in accordance with manufacturer's instructions.

B. Install units level and plumb in cabinets and surface mount as indicated on the drawings.

3.5 INSTALLATION - CABINETS

A. Install cabinets and accessories in accordance with manufacturer's instructions.

B. Product: Cabinets and accessories as indicated on the Detail Drawing No. A7 and A8

3.6 INSTALLATION – QUARTZ COUNTERTOPS AND BACKSPLASH

A. Install Quartz countertops & backsplash in accordance with manufacturers instructions

B. Secure tops level & plumb

C. Caulk between top & wall

3.7 INSTALLATION – VANITY TOPS

A. Install vanity tops in accordance with manufacturers instructions

B. Secure tops level & plumb

C. Caulk between top & wall

3.8 INSTALLATION - ACCESS PANELS

A. Install attic access panels in accordance with manufacturer's instructions.

B. Furnish and install access panels at locations approved by the Architect.

3.9 INSTALLATION - HANDRAIL

A. Install stair handrail in accordance with manufacturer's instructions.

B. Handrail to be installed as indicated on the Detail Drawing.

3.10 INSTALLATION – CORRIDOR HANDRAIL

A Handrail to be installed as indicated on the Detail Drawing.

3.11 INSTALLATION – SIGNAGE

A. Install signage in accordance with manufacturer's instructions.

B. Interior Signage Schedule

Door Location	Sign to Read
Next to Apartment Doors	101-118 201-222
B02, 227	Mechanical
B03	Electric Room
B05, B09, B13, 102, 104, 146, 203, 205, 223, 230	Storage
B04, 113	Pantry

B07, B10	Physical Therapy
B10A	Beauty Parlor
B11, 131, 214	Lavatory
B08, 114, 213, 216, 221	Office
B15	Water Room
B16	Staff Locker Room
110, 123	Dining
122	Private Dining
121, 125, 124	Medical Office
126	Administration
128, 133	Conference
144	Therapy
145	Doctor Office
210	Library
211	Computer Lounge
212	Television Room
218	Activities
229	Tub Room
Next to Elevator Doors (2 – Required)	IN FIRE EMERGENCY DO NOT USE ELEVATOR USE EXIT STAIRS (WITH SYMBOL)
Inside Stairways at Doors	STAIR 1 BASEMENT EXIT THIS LEVEL
	STAIR 1 FLOOR 1 EXIT ON BASEMENT
	STAIR 1 FLOOR 2 EXIT ON BASEMENT
	STAIR 2 BASEMENT EXIT ON THIS LEVEL
	STAIR 2

	FLOOR 1 EXIT ON BASEMENT
	STAIR 3 BASEMENT EXIT ON THIS LEVEL
	STAIR 3 FLOOR 1 EXIT ON BASEMENT
	STAIR 3 FLOOR 2 EXIT ON BASEMENT
	STAIR 4 FLOOR 1 EXIT ON THIS LEVEL
	STAIR 4 FLOOR 2 EXIT ON 1
	STAIR 5 FLOOR 1 EXIST ON THIS LEVEL STAIR 5 FLOOR 2 EXIT ON 1
B18, 138	WOMEN'S LAVATORY WITH HANDICAP SYMBOL
B17, 139	MEN'S LAVATORY WITH HANDICAP SYMBOL
NEXT TO STAIR DOOR 201, 206, 222, 225, 231	Exit Stair with symbol
B01, B19, B20, 106, 148	Exit
108, 208	Laundry
109, 202, 209, 226	Linen Closet
103, 116, 143, 204, 228	Janitor Closet

3.11 INSTALLATION - FRP PANEL

A. Install FRP panels in accordance with manufacturer's instructions.

B. Install top edge "J" molding and T moldings at all panel butt joints. Caulk between panels, floor, and service sink.

END OF SECTION

SECTION 102800

TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Toilet and bath, shower, washroom accessories.
B. Grab bars.
C. Section 06100 - Rough Carpentry: Placement of concealed anchor devices.

1.2 SYSTEM DESCRIPTION

A. Conform to applicable code for installing work in conformance with ANSI A117.1.

1.2 SUBMITTALS

A. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manufacturers: American Specialties, Inc., or equal.
A&J Washroom Accessories
Bobrick Washroom Accessories
B. Sheet Steel: ASTM A366.
C. Stainless Steel Sheet: ASTM A167 Type 304.
D. Tubing: ASTM A269 stainless steel.
E. Plastic Laminate: General Purpose; 1/16 inch thick, finish, color, pattern, as selected.
F. Adhesive: Two component epoxy, waterproof.
G. Fasteners, Screws, and Bolts: Hot dip galvanized steel.

2.2 FABRICATION

A. Form surfaces flat without distortion. Weld and grind joints smooth.
B. Shop assemble components and package with anchors and fittings.
C. Back paint components to prevent electrolysis.
D. Provide steel anchor plates, adapters, and anchor components for installation.
E. Hot dip galvanize exposed and painted ferrous metal and fastening devices.

2.3 FINISHES

A. Anchors: Galvanize to 1.25 oz/sq yd.
B. Ferrous Metals - Shop Primed: Pre-treat and clean, spray apply one coat primer and bake.
C. Enamel: Pre-treat, one coat primer and two coats electrostatic baked enamel.
D. Chrome/Nickel Plating: ASTM B456, Type SC 2; satin polished finish.
E. Stainless Steel: No. 4 satin luster finish.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify exact location of accessories for installation.
B. Deliver inserts & rough-in frames to site. Provide templates & rough-in measurements as required.

3.2 INSTALLATION

A. Install fixtures, accessories and items in accordance with manufacturers' instructions.
B. Install plumb and level, securely and rigidly anchored to substrate.

3.3 ACCESSORIES SCHEDULE

MK	Name	Description	MFR	Cat. No.	Remarks
MC	Medicine Cabinet	Surf. Mtd.	Jensen	18x30 SS8 WB/ST	18" x 30" surface mount, single door, medicine cabinet
M-1	Mirror	Surf. Mtd.	-	-	18"x36", Beveled Edge, Provide cutout Soap Dispenser
TPH-1	Tissue Holder	Single Roll -Surf Mtd	A & J	UC41	
TPH-2	Tissue Holder	Double Roll-Surf Mtd	A & J	U804	Lock
GB-18	Grab Bar	1 1/2" dia. x 18" L	A & J	UG130A	Provide Blocking
GB-36	Grab Bar	1 1/2" dia. x 36" L	A & J	UG130A	Provide Blocking
GB-42	Grab Bar	1 1/2" dia. x 42" L	A & J	UG130A	Provide Blocking
TB-12, 18, 24	Towel Bar	Towel Bar Length as Indicated	A & J	UC31	Provide Blocking
H	Towel Hook	Double Towel Hook	A & J	UC12	Provide Blocking

CR	Curtain Rod	1" dia. x 60" L	A & J	UX163	Provide Blocking
SD	Sensor Activated Soap Dispenser	Surf. Mtd	A & J	U135 EA	Provide Batteries & Blocking
PTD	Sensor Activated Paper Towel Dispenser	Surf. Mtd	A & J	U199	Provide Batteries & Blocking

END OF SECTION

SECTION 113013
RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Washer, Dryer

1.2 SYSTEM DESCRIPTION

A. Equipment: Conform to applicable code for UL approval.

1.3 SUBMITTALS

A. Product Data: Provide data on equipment and accessories.

B. Operating and Maintenance Instructions: Include relevant instructions.

C. Submit manufacturer's installation instructions.

1.4 WARRANTY

A. Provide twelve-month warranty under provisions of Section 01001.

PART 2 PRODUCTS

2.1 WASHER AND DRYER

A. Manufacturer equal to Maytag Commercial Laundry

B. Washer - Model Maytag #MHN33PD, Front Load Washer, Coin Operated, Energy Star, free standing type, color – white.

C. Dryer - Model Maytag #MLE26PD – stack electric dryers, coin operated, free standing type, removable lint screen, color – white

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that openings and utility services are ready to receive work and opening dimensions are as indicated on shop drawings.

3.2 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Set and adjust units level and plumb.

C. Activate units to confirm correct operation.

END OF SECTION

SECTION 122416

PLEATED WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pleated Shades

1.2 SYSTEM DESCRIPTION

A. Pleated Shades: All First and Second Floor Windows

1.3 SUBMITTALS

A. Product Data: Provide data indicating colors available.

B. Samples: Submit two samples, 4 inches long illustrating shade materials and finish, color, cord and color.

PART 2 PRODUCTS

2.1 HORIZONTAL LOUVER BLIND

A. Manufacturers: Equal to Hunter Douglas Pleated Shades

B. Width: Each Window opening shall be fitted with a single pleated shade equal to the width of that opening.

C. Material: Manufacturer's Standard Materials and Colors

D. Privacy & Light Control: Softened Light, Substantial Privacy

E. Operating System: Cordlock Operation

F. Cord: Braided nylon: continuous loop, free and weighted.

G. Head Support Bracket: Manufacturer's Standard

H. Accessory Hardware: Type recommended by shade manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that openings are ready to receive work.

3.2 INSTALLATION

A. Install pleated shades in accordance with manufacturer's instructions.

B. Secure in place with concealed fasteners.

C. Adjust shades for smooth operation.

END OF SECTION

SECTION 142400

HYDRAULIC ELEVATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Passenger elevator system, Two (2) required.

B. Motor and pump, controllers, and equipment.

1.2 SYSTEM DESCRIPTION

A. Hydraulic Elevator System: One unit; buried cylinder and casing or hole less hoist way cylinder, with motor and pump adjacent to hoistway. Equal to Thyssen Krupp Endura, Above Ground (1-stage)

B. Characteristics of the elevator are as follows:
1. Rated Net Capacity: 3,500 lbs.
2. Rated Speed: 100 ft/min.
3. Automatic Lowering
4. Clear Net Platform Size: 80 x 51 inches.
5. Hoistway and Cab Entrance Frame Opening Sizes: 42 x 88 inches.
6. Door Type: Single leaf.
7. Door Operation: Side opening.
8. Elevator No.1: Number of Stops: 3
9. Elevator No. 2: Number of Stops: 2
10. Elevator No.1: Number of Openings: 4 (3 Front and 2 Rear)
11. Elevator No. 2: Number of Openings 2
12. Handrails: two side walls – 1 ½" diameter.
13. Provide Removable wall mats.

C. Finishes
1. Floor Finish to be Sheet Vinyl No. 1 (SV-1)which will be furnished and installed by the Flooring Contractor.
2. Wall and Ceiling Panels must be Powder Coat
3. Handrails must be Stainless Steel
4. Lighting must be Downlight with LED
5. Hoistway Door & Frame: Powder Coat
6. Cab Door & Front Wall Finish: Brushed Stainless Steel

D. Controls System: Conform to the following criteria:
1. Single Automatic Operation elevator control system.
2. Lighted call button at each landing.
3. Position indicator in the car.
4. Prominent direction arrows in the car and at each landing.
5. Audible signals which sound at each floor, sounding once in the up direction and sounding twice in the down direction.

6. Emergency call phone connected to the reception office
7. An in-car alarm button.

8. Additional Traveling Cables for the installation of an electronic reader for floor access and a closed circuit TV camera.
9. Electronic lock out of all floors

E. Special Operational Features:
1. Interconnect with building fire and smoke alarm system.

1.3 SUBMITTALS

A. Shop Drawings: Indicate the following minimum information on shop drawings:
1. Motor and hydraulic pump, valves, and other component locations.
2. Car, supporting beams, guide rails, and other components in hoistway.
3. Loads on hoisting beams.
4. Elevator control functions and operational description.

B. Product Data: Provide data on the following items:
1. Signal and operating fixtures, operating panels, indicators.
2. Cab design, dimensions, layout, and components.
3. Cab and hoistway door and frame details.

C. Schematic: Provide legible schematic of hydraulic piping and electric wiring diagrams describing installed equipment. Provide one copy of master schematic, mounted in plastic glazed metal frame, mounted on machine room wall.

D. Samples: Submit three samples illustrating cab floor material, cab interior finishes, cab and hoistway door and frame finishes.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the following:
1. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People and the Uniform Federal Accessibility Standards.
2. ANSI/ASME A17.1 - Safety Code for Elevators and Escalators.
3. ANSI/UL 10B - Fire Tests of Door Assemblies.
4. Building Code of New York State
5. Applicable Local Building Codes
6. HUD Minimum Property Standards

1.5 MAINTENANCE

A. Include description of elevator system's method of operation, control description, motor control system, cab and hoistway door operation, visual and audio signals, and specified non-standard features.

B. Include a parts catalog with complete list of equipment replacement parts.

C. Include legible schematic wiring diagrams of installed electrical equipment.

1.6 GUARANTEE

A. Provide written guarantee from the manufacturer to cover parts and components for a period of one year after the date of final acceptance.

B. Repairs or replacements made under the guarantee, must be guaranteed for an additional one year period.

1.7 SERVICE CONTRACT

A. Elevator Contractor must provide a service contract to cover maintenance and callback service for a period of one year after the ate of final acceptance by Owner. Coverage must include regular and systematic examination, adjustment, lubrication, and repair and/or replacement of equipment whenever required by the wear and tear of normal elevator usage. A service contract must be in continual enforcement for the entire length of the regulatory period.

B. Owners are required to provide an Annual Service Contract for continual coverage for the entire length of the regulatory period. Service Contracts are to provide the same level of coverage as outlined above.

PART 2 PRODUCTS

A.1 ELEVATOR SYSTEM AND COMPONENTS

A. Manufacturers: Equal to: Thyssen Krupp's 3,500-pound hydraulic elevator (Endura MRL Above Ground 2-stage)

B. Structural Components, Cylinder and Casing: Required to construct elevator system and conform to code.

C. Sheet Steel: ASTM A366 Class 1.

D. Stainless Steel: ASTM A167 Type 304, No. 4 finish.

E. Aluminum: ASTM B221, extruded.

F. Motors, Pumps, Valves, Regulators, Fluid Tank, Hydraulic Fluid, Controller, Controls, Buttons, Wiring and Devices, Indicators: UL approved.

G. Spring Buffers, Attachment Brackets and Anchors: Purpose designed, sized according to code with safety factors.

H. Pump Housing: Sheet steel, acoustically insulated, removable.

2.2 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: 25 h.p., 208 volt, 3 phase, 60 cycle.

B. Disconnect Switches: Provided by the electrical contractor.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., or other testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that hoistway, pit and machine room are ready for work of this Section.

B. Verify shaft and openings are of correct size and within tolerances.

C. Verify that electrical power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with ANSI/ASME A17.1.

B. Install system components and connect to building utilities.

C. Accommodate equipment in space indicated.

D. Coordinate installation of hoistway wall construction.

E. Grout sills in place. Set entrances in vertical alignment with car openings and aligned with plumb hoistway lines.

F. Fill hoistway door frames solid with grout.

G. Adjust for smooth acceleration and deceleration of car so not to cause passenger discomfort.

H. Adjust automatic floor leveling feature at each floor to achieve 1/4 inch from flush.

3.3 TESTS BY REGULATORY AGENCIES

A. Obtain required permits to perform tests. Perform tests required by regulatory agencies.

END OF SECTION

SECTION 210500 - BASIC FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, tools, materials, accessories, parts, transportation, taxes, and related items, essential for installation of the work and necessary to make work, complete, and operational. Provide new equipment and material unless otherwise called for. References to codes, specifications and standards called for in the specification sections and on the drawings mean, the latest edition, amendment and revision of such referenced standard in effect on the date of these contract documents. All materials and equipment shall be installed in accordance with the manufacturer's recommendations.

1.2 LICENSING

A. The Contractor shall hold a license to perform the work as issued by the authority having jurisdiction.

B. Plumbing contract work shall be performed by, or under, the direct supervision of a licensed master plumber.

C. Electrical contract work shall be performed by, or under, the direct supervision of a licensed electrician.

1.3 PERMITS

A. Apply for and obtain all required permits and inspections, pay all fees and charges including all service charges. Provide certificate of approval from the Authorities Having Jurisdiction prior to request for final payment.

B. Provide electrical inspection certificate of approval from Middle Department Inspection Agency, Commonwealth Inspection Agency, or an Engineer approved Inspection Agency prior to request for final payment.

1.4 CODE COMPLIANCE

A. Provide work in compliance with the following:

1. 2020 Building Code of New York State.
2. 2020 Fire Code of New York State.
3. 2020 Plumbing Code of New York State.
4. 2020 Mechanical Code of New York State.
5. 2020 Fuel Gas Code of New York State.
6. 2020 Property Maintenance Code of New York State.
7. 2020 Energy Conservation Code of New York State

8. Accessible and Usable Buildings and Facilities, ICC A117.1 (2009).

9. New York State Department of Labor Rules and Regulations.

10. New York State Department of Health.

11. 2017 National Electrical Code (NEC).

12. Occupational Safety and Health Administration (OSHA).

13. Local Codes and Ordinances.

14. Life Safety Code, NFPA 101.

1.5 GLOSSARY

ACI	American Concrete Institute
AGA	American Gas Association
AGCA	Associated General Contractors of America, Inc.
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AFBMA	Anti-Friction Bearing Manufacturer's Association
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing Materials
AWSC	American Welding Society Code
AWWA	American Water Works Association
FM	Factory Mutual Insurance Company
IBR	Institute of Boiler & Radiation Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association

NYS/DEC	New York State Department of Environmental Conservation
SBI	Steel Boiler Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UFPO	Underground Facilities Protective Organization
UL	Underwriter's Laboratories, Inc.
OSHA	Occupational Safety and Health Administration
XL - GAP	XL Global Asset Protection Services

1.6 DEFINITIONS

Acceptance	Owner acceptance of the project from Contractor upon certification by Owner's Representative.
As Specified	Materials, equipment including the execution specified/shown in the contract documents.
Basis of Design	Equipment, materials, installation, etc. on which the design is based. (Refer to the article, Equipment Arrangements, and the article, Substitutions.)
Code Requirements	Minimum requirements.
Concealed	Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.
Coordination Drawings	Show the relationship and integration of different construction elements and trades that require careful coordination during fabrication or installation, to fit in the space provided or to function as intended.
Delegated-Design Services	Performance and Design criteria for Contractor provided professional services. Where professional design services or certifications by a design professional are specifically required of a Contractor, by the Contract Documents. Provide products and systems with the specific design criteria indicated. If criteria indicated is insufficient to perform services or certification required, submit a written request for additional information to the Engineer. Submit wet signed and sealed certification by the licensed design professional for each product and system specifically assigned to the Contractor to be designed or certified by a design professional. Examples: structural maintenance ladders, stairs and platforms, pipe anchors, seismic compliant system, wind, structural supports for material equipment, sprinkler hydraulic calculations.
Equal, Equivalent, Equal To, Equivalent To, As Directed and As Required	Shall all be interpreted and should be taken to mean "to the satisfaction of the Engineer".
Exposed	Work not identified as concealed.
Extract	Carefully dismantle and store where directed by Owner's Representative

	and/or reinstall as indicated on drawings or as described in specifications.
Furnish	Purchase and deliver to job site, location as directed by the Owner's Representative.
Inspection	Visual observations by Owner's site Representative.
Install	Store at job site if required, proper placement within building construction including miscellaneous items needed to affect placement as required and protect during construction. Take responsibility to mount, connect, start-up and make fully functional.
Labeled	Refers to classification by a standards agency.
Manufacturers	Refer to the article, Equipment Arrangements, and the article, Substitutions.
Prime Professional	Architect or Engineer having a contract directly with the Owner for professional services.
Product Data	Illustrations, standard schedules, performance charts, instructions, brochures, wiring diagrams, finishes, or other information furnished by the Contractor to illustrate materials or equipment for some portion of the work.
Provide (Furnish and Install)	Contractor shall furnish all labor, materials, equipment and supplies necessary to install and place in operating condition, unless otherwise specifically stated.
Relocate	Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use.
Remove	Dismantle and take away from premises without added cost to Owner, and dispose of in a legal manner.
Review and Reviewed	Should be taken to mean to be followed by "for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents".
Roughing	Pipe, duct, conduit, equipment layout and installation.
Samples	Physical full scale examples which illustrate materials, finishes, coatings, equipment or workmanship, and establishes standards by which work will be judged.
Satisfactory	As specified in contract documents.
Shop Drawings	Fabrication drawings, diagrams, schedules and other instruments, specifically prepared for the work by the Contractor or a Sub-contractor, manufacturer, supplier or distributor to illustrate some portion of the work.
Site Representative	Owner's Inspector or "Clerk of Works" at the work site.
Submittals Defined (Technical)	Any item required to be delivered to the Engineer for review as requirement of the Contract Documents. The purpose of technical submittals is to demonstrate for those portions of the work for which a submittal is required, the manner in which the Contractor proposes to conform to the information given and design concepts expressed and required by the Contract Documents.

1.7 SHOP DRAWINGS/PRODUCT DATA/SAMPLES

A. Provide submittals on all items of equipment and materials to be furnished and installed. Submittals shall be accompanied by a transmittal letter, stating name of project and contractor, name of vendor supplying equipment, number of drawings, titles, specification sections (name and number) and other pertinent data called for in individual sections. Submittals shall have individual cover sheets that shall be dated and contain: Name of project; name of prime professional; name of prime contractor; description or names of equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Individual piecemeal or incomplete submittals will not be accepted. Similar items, (all types specified) shall be submitted at under one cover sheet per specification section (e.g. valves, plumbing fixtures, etc.). Number each submittal by trade. Indicate deviations from contract requirements on Letter of Transmittal. Submittals will be given a general review only. Corrections or comments made on the Submittals during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. If submitting hard copies, submit four (4) copies for review.

B. If submittals are to be submitted electronically, all requirements in Item A apply. Submittals shall be emailed in PDF format to specific email address provided by the Construction Manager, General Contractor, Architect or Project Manager. Name of project shall be in subject line of email. Send emails to mealbasubmittalclerk@meengineering.com.

C. Refer to Division 01 for additional requirements.

1.8 PROTECTION OF PERSONS AND PROPERTY

A. Contractor shall assume responsibility for construction safety at all times and provide, as part of contract, all trench or building shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, and other safety feature required to provide safe conditions for all workmen and site visitors.

1.9 EQUIPMENT ARRANGEMENTS

A. The contract documents are prepared using one manufacturer as the Basis of Design, even though other manufacturers' names are listed. If Contractor elects to use one of the listed manufacturers other than Basis of Design, submit detailed drawings, indicating proposed installation of equipment. Show maintenance clearances, service removal space required, and other pertinent revisions to the design arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger motors, feeders, breakers, and equipment, additional control devices, valves, fittings and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of roughing and connections by other trades. Remove and replace doorframes, access doors, walls, ceilings, or floors required to install other than Basis of

Design. If revised arrangement submittal is rejected, revise and resubmit specified Basis of Design item which conforms to Contract Documents.

1.10 SUBSTITUTIONS

A. If Contractor desires to bid on any other kind, type, brand, or manufacture of material or equipment than those named in specifications, secure prior approval. To request such approval, Contractor shall submit complete information comparing (item-for-item) material or equipment offered with design material or equipment. Include sufficient information to permit quick and thorough comparison, and include performance curves on same basis, capacities, power requirements, controls, materials, metal gauges, finishes, dimensions, weights, etc., of major parts. If accepted, an addendum will be issued to this effect ahead of bid date. Unless such addendum is issued, substitution offered may not be used.

1.11 UTILITY COMPANY SERVICES

A. Division 26 shall make arrangements with National Grid for electric service to the Owner's distribution equipment. Provide underground or overhead electric service as called for and transformers, meter sockets or meter compartments as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the electric service shall comply with the published Utility Company standards

B. Division 22 shall make arrangements with National Grid for gas service to the Owner's distribution system. Provide service to the building as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the gas service shall comply with the published Utility Company standards

1.12 ROUGHING

A. The Contract Drawings have been prepared in order to convey design intent and are diagrammatic only. Drawings shall not be interpreted to be fully coordinated for construction.

B. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Make necessary changes in contract work, equipment locations, etc., as part of a contract to accommodate work to avoid obstacles and interferences encountered. Before installing, verify exact location and elevations at work site. DO NOT SCALE plans. If field conditions, details, changes in equipment or shop drawing information require an important rearrangement, report same to Owner's Representative for review. Obtain written approval for all major changes before installing.

C. Install work so that items both existing and new are operable and serviceable. Eliminate interference with removal of coils, motors, filters, belt guards and/or operation of doors. Provide easy, safe, and code mandated clearances at controllers, motor starters, valve access, and other equipment requiring maintenance and operation. Provide new materials, including new piping and insulation for relocated work.

D. Coordinate work with other trades and determine exact route or location of each duct, pipe, conduit, etc., before fabrication and installation. Coordinate with Architectural Drawings. Obtain from Owner's Representative exact location of all equipment in finished areas, such as thermostat, fixture, and switch mounting heights, and equipment mounting heights. Coordinate all work with the architectural reflected ceiling plans and/or existing Architecture. Mechanical and electrical drawings show design arrangement only for diffusers, grilles, registers, air terminals, lighting fixtures, sprinklers, speakers, and other items. Do not rough-in contract work without reflected ceiling location plans.

E. Before roughing for equipment furnished by Owner or in other Divisions, obtain from Owner and other Divisions, approved roughing drawings giving exact location for each piece of equipment. Do not "rough in" services without final layout drawings approved for construction. Cooperate with other trades to insure proper location and size of connections to insure proper functioning of all systems and equipment. For equipment and connections provided in this contract, prepare roughing drawing as follows:

1. Existing Equipment: Measure the existing equipment and prepare for installation in new location.

2. New Equipment: Obtain equipment roughing drawings and dimensions, then prepare roughing-in-drawings. If such information is not available in time, obtain an acknowledgement in writing, then make space arrangements as required with Owner's Representative.

1.13 COORDINATION DRAWINGS

A. Before construction work commences, Divisions for all trades shall submit coordination drawings in the form of CAD drawing files, drawn at not less than 1/4 in. scale. Such drawings will be required throughout all areas, for all Contracts. These drawings shall show resolutions of trade conflicts in congested areas. Mechanical Equipment Rooms shall be drawn early in coordination drawing process simultaneous with all other congested areas. Prepare Coordination Drawings as follows:

1. Division 23 shall prepare the base plan CAD coordination drawings showing all ductwork, all pertinent heating piping, and equipment. These drawings may be CAD files of the required Ductwork Shop Drawings. The drawings shall be coordinated with lighting fixtures, sprinklers, air diffusers, other ceiling mounted items, ceiling heights, structural work, maintenance clearances, electric code clearance, reflected ceiling plans, and other contract requirements. Reposition proposed locations of work after coordination drawing review by the Owner's Representative. Provide adjustments to exact size, location, and offsets of ducts, pipes, conduit, etc., to achieve reasonable appearance objectives. Provide these adjustments as part of contract. Minor revisions need not be redrawn.

2. Division 23shall provide CAD files and submit the base plan CAD Coordination Drawings to all Divisions.

3. Divisions 21 and 22 shall draw the location of piping and equipment on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolutions.

4. Divisions 26, 27 and 28 shall draw the location of lighting fixtures, cable trays, and feeders over 1-1/2 in. on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolution.

5. The General Construction Trade shall indicate areas of architectural/structural conflicts or obstacles on the CAD Coordination Drawings, and coordinate to suit the overall construction schedule.

6. The General Construction Trade shall expedite all Coordination Drawing work and coordinate to suit the overall construction schedule. In the case of unresolved interferences, he shall notify the Owner's Representative. The Owner's Representative will then direct the various trades as to how to revise their drawings as required to eliminate installation interferences.

7. If a given trade proceeds prior to resolving conflicts, then if necessary, that trade shall change its work at no extra cost in order to permit others to proceed with a coordinated installation. Coordination approval will be given by areas after special site meetings involving all Divisions.

B. The purpose of the coordination drawing process is to identify and resolve potential conflicts between trades, and between trades and existing or new building construction, before they occur in construction. Coordination drawings are intended for the respective trade's use during construction and shall not replace any Shop Drawings, or record drawings required elsewhere in these contract documents.

1.14 EQUIPMENT AND MATERIAL REQUIREMENTS

A. Provide materials that meet the following minimum requirements:

1. Materials shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less, in accordance with NFPA 255.

2. All equipment and material for which there is a listing service shall bear a UL label.

3. Potable water systems and equipment shall be built according to AWWA Standards.

4. Gas-fired equipment and system shall meet AGA Regulations and shall have AGA label.

5. Fire protection equipment shall be UL listed and FM approved.

B. Exterior and wet locations shall utilize materials, equipment supports, mounting, etc. suitable for the intended locations. Metals shall be stainless steel, galvanized or with baked enamel finish as a minimum. Finishes and coatings shall be continuous and any surface damaged or cut ends shall be field corrected in accordance with the manufacturer's recommendations. Hardware (screws, bolts, nuts, washers, supports, fasteners, etc.) shall be:

1. Stainless steel where the associated system or equipment material is stainless steel or aluminum.

2. Hot dipped galvanized or stainless steel where the associated system or equipment is steel, galvanized steel or other.

1.15 CUTTING AND PATCHING

A. Each trade shall include their required cutting and patching work unless shown as part of the General Construction Contract. Refer to General Conditions of the Contract for Construction, for additional requirements. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch cut or abandoned holes left by removals of equipment or fixtures. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

1.16 PAINTING

A. Paint all insulated and bare piping, pipe hangers and supports exposed to view in mechanical equipment rooms, penthouse, boiler rooms and similar spaces. Paint all bare piping, ductwork and supports exposed to the out-of-doors with rust inhibiting coatings. Paint all equipment that is not factory finish painted (i.e. expansion tanks, etc.).

B. All painting shall consist of one (1) prime coat and two (2) finish coats of non-lead oil base paint, unless otherwise indicated herein. Provide galvanized iron primer for all galvanized surfaces. All surfaces must be thoroughly cleaned before painting. Review system color coding prior to painting with the Owner's Representative or Architect.

C. All items installed after finished painting is completed and any damaged factory finish paint on equipment furnished under this contract must be touched up by the Contractor responsible for same.

D. Include painting for patchwork with color to match adjacent surfaces. Where color cannot be adequately matched, paint entire surface. Provide one (1) coat of primer and two (2) finish coats or as called for in the Specifications.

E. All primers and paint used in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

F. Refer to Division 9 - Finishes, for additional information.

1.17 CONCEALMENT

A. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

1.18 CHASES

A. New Construction:

1. Certain chases, recesses, openings, shafts, and wall pockets will be provided as part of General Construction Trade. Mechanical and Electrical trades shall provide all other openings required for their contract work.

2. Check Architectural and Structural Design and Shop Drawings to verify correct size and location for all openings, recesses and chases in general building construction work.

3. Assume responsibility for correct and final location and size of such openings.

4. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.

5. Provide 18 gauge galvanized sleeves and inserts. Extend all sleeves 2 in. above finished floor. Set sleeves and inserts in place ahead of new construction, securely fastened during concrete pouring. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Firestop all unused sleeves.

6. Provide angle iron frame where openings are required for contract work, unless provided by General Construction trade.

1.19 PENETRATION FIRESTOPPING

A. Fire-Stopping for Openings Through Fire and Smoke Rated Wall and Floor Assemblies:

1. Provide materials and products listed or classified by an approved independent testing laboratory for "Penetration Fire-Stop Systems". The system shall meet the requirements of "Fire Tests of Penetrations Fire-Stops" designated ASTM E814.

2. Provide fire-stop system seals at all locations where piping, tubing, conduit, electrical busways/cables/wires, ductwork and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities which permit the easy removal or addition of electrical conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion, and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating.

5. Plastic pipe/conduit materials shall be installed utilizing intumescent collars.

6. Provide a submittal including products intended for use, manufacturer's installation instructions, and the UL details for all applicable types of wall and floor penetrations.

7. Fire-stopping products shall not be used for sealing of penetrations of non-rated walls or floors.

B. Acceptable Manufacturers:

1. Dow Corning Fire-Stop System Foams and Sealants.

2. Nelson Electric Fire-Stop System Putty, CLK and WRP.

3. S-100 FS500/600, Thomas & Betts.

4. Carborundum Fyre Putty.

5. 3-M Fire Products.

6. Hilti Corporation.

1.20 NON-RATED WALL PENETRATIONS

A. Each trade shall be responsible for sealing wall penetrations related to their installed work, including but not limited to ductwork, piping, conduits, etc. See individual specification sections for requirements.

1.21 SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, and other items to properly support contract work. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above.

B. For precast panels/planks and metal decks, support mechanical/electrical work as determined by manufacturer and the Engineer. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

C. For finished areas without a finished ceiling system such as classrooms, offices, conference rooms, etc., where decking and structure is exposed, and ductwork/piping/conduit is exposed: All mounting brackets, channel support systems and mounting hardware for ductwork, piping, lighting, etc. shall be concealed and approved by the Architect/Engineer prior to the installation. AirCraft cable style hanging for ductwork is required. It is recommended that room mockups be done and receive Architect/Engineer approval prior to proceeding with installation.

D. Equipment, piping, conduit, raceway, etc. supports shall be installed to minimize the generation and transmission of vibration.

E. Materials and equipment shall be solely supported by the building structure and connected framing. Gypboard, ceilings, other finishes, etc. shall not be used for support of materials and equipment.

1.22 ACCESS PANELS

A. Provide access panels for required access to respective trade's work. Location and size shall be the responsibility of each trade. Access panels provided for equipment shall provide an opening not smaller than 22 in. by 22 in. Panels shall be capable of opening a minimum of 90 degrees. Bear cost of construction changes necessary due to improper information or failure to provide proper information in ample time. Access panels over 324 square inches shall have two cam locks. Provide proper frame and door type for various wall or ceiling finishes. Access panels shall be equal to "Milcor" as manufactured by Inland Steel Products Co., Milwaukee, Wisconsin. Provide General Construction trade with a set of architectural plans with size and locations of access panels.

1.23 CONCRETE BASES

A. Provide concrete bases for all floor mounted equipment. Provide 3,000 lb. concrete, chamfer edges, trowel finish, and securely bond to floor by roughening slab and coating with cement grout. Bases 4 in. high (unless otherwise indicated); shape and size to accommodate equipment. Provide anchor bolts in equipment bases for all equipment provided for the project, whether mounted on new concrete bases or existing concrete bases.

1.24 HVAC EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide final connections to all equipment as required by the equipment. Provide final connections, including domestic water piping, wiring, controls, and devices from equipment to outlets left by other trades. Provide equipment waste, drip, overflow and drain connections extended to floor drains.

C. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, as required.

1.25 PLUMBING EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide roughing and final connections to all equipment. Provide loose key stops, sanitary "P" traps, tailpiece, adapters, gas or air cocks, and all necessary piping and fittings from roughing point to equipment. Provide installation of sinks, faucets, traps, tailpiece furnished by others. Provide cold water line with gate valve and backflow prevention device at locations called for. Provide continuation of piping and connection to equipment that is furnished by others. Provide relief valve discharge piping from equipment relief valves.

C. Provide valved water outlet adjacent to equipment requiring same. Provide equipment type floor drains, or drain hubs, adjacent to equipment.

D. Install controls and devices furnished by others.

E. Refer to Contract Documents for roughing schedules, and equipment and lists indicating scope of connections required.

F. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, as required.

1.26 ELECTRICAL EQUIPMENT CONNECTIONS

A. Provide complete power connections to all electrical equipment. Provide control connections to equipment. Heavy duty NEC rated disconnect ahead of each piece of equipment. Ground all equipment in accordance with NEC.

B. Provide for Owner furnished and Contractor furnished equipment all power wiring, electric equipment, control wiring, switches, lights, receptacles, and connections as required.

1.27 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

A. Store Materials on dry base, at least 6 in. aboveground or floor. Store so as not to interfere with other work or obstruct access to buildings or facilities. Provide waterproof/windproof covering. Remove and provide special storage for items subject to moisture damage. Protect against theft or damage from any cause. Replace items stolen or damaged, at no cost to Owner.

B. Refer to Division 01 for additional information.

1.28 FREEZING AND WATER DAMAGE

A. Take all necessary precautions with equipment, systems and building to prevent damage due to freezing and/or water damage. Repair or replace, at no change in contract, any such damage to equipment, systems, and building. Perform first seasons winterizing in presence of Owner's operating staff.

1.29 OWNER INSTRUCTIONS

A. Before final acceptance of the work, furnish necessary skilled labor to operate all systems by seasons. Instruct designated person on proper operation, and care of

systems/equipment. Repeat instructions, if necessary. Obtain written acknowledgement from person instructed prior to final payment. Contractor is fully responsible for system until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing. List under clear plastic, operating, maintenance, and starting precautions procedures to be followed by Owner for operating systems and equipment.

1.30 OPERATION AND MAINTENANCE MANUALS

A. Submit by email (preferred) or digital media, thru the normal project submittal process. Include a copy of each final approved Shop Drawing, wiring diagrams, piping diagrams, spare parts lists, final testing and balancing report, as-built drawings and manufacturer's instructions. Include typewritten instructions, describing equipment, starting/operating procedures, emergency operating instructions, summer-winter changeover, freeze protection, precautions and recommended maintenance procedures. Include name, address, and telephone number of installing contractor and of supplier manufacturer Representative and service agency for all major equipment items. Provide a table of contents page and dividers based upon specification section numbers. Submit in a compiled and bookmarked PDF format as outlined below.

B. Provide content for Operation and Maintenance Manuals as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer and Commissioning Agent will comment on whether content of operation and maintenance submittals is acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

C. Submit Operation and Maintenance Manuals in the following format:

1. Submit by uploading to web-based project software site, or by email to Architect, as a formal project submittal in conformance with the project specific submittal procedures. Enable reviewer comments on draft submittals.

2. 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.

3. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in the 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.

D. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing Owner training. Engineer and Commissioning Agent will comment on whether general scope and content of manual are acceptable.

E. Final Manual Submittal: Submit O&M manual in final form prior to requesting inspection for Substantial Completion and at least 2 weeks before commencing Owner training. Engineer and Commissioning Agent will return copy with review comments.

1. Correct or revise O&M manual to comply with Engineer's and Commissioning Agent's comments. Submit copies of each corrected manual within 2 weeks of receipt of Engineer's and Commissioning Agent's comments.

F. Refer to Division 01 for additional requirements.

1.31 RECORD DRAWINGS

A. The Contractor shall obtain at his expense one (1) set of construction Contract Drawings, (including non-reproduction black and white prints or electronic files) for the purpose of recording as-built conditions.

B. The Contractor shall perform all survey work required for the location and construction of the work and to record information necessary for completion of the record drawings. Record drawings shall show the actual location of the constructed facilities in the same manner as was shown on the bid drawings. All elevations and dimensions shown on the drawings shall be verified or corrected so as to provide a complete and accurate record of the facilities as constructed.

C. It shall be the responsibility of the Contractor to mark EACH sheet of the contract documents in red and to record thereon in a legible manner, any and all approved field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other changes shall also be maintained. At completion of the work, the complete set of red marked contract documents, plus all approved field sketches and diagrams shall be submitted to the engineer and used in preparation of the record drawings.

D. A complete set of red marked contract drawings shall be submitted, at one time, as the "Record" set. If there are no changes to a specific drawing, the contractor shall indicate "NO CHANGES" on that drawing. ALL drawings shall be included in the "Record" set.

E. The complete set of red marked Contract Documents or electronic files shall be certified by the Contractor as reflecting record conditions and submitted to the engineer for review.

F. The Contractor shall have the marked up set scanned, if they are not already electronic files, and then submit them to the Engineer as the "Record Set".

G. Refer to Division 01 for additional requirements.

1.32 FINAL INSPECTION

A. Upon completion of all Engineering Site Observation list items, the Contractor shall provide a copy of the Engineering Site Observation Report back to the Engineer with each items noted as completed or the current status of the item. Upon receipt, the Engineer will schedule a final review.

1.33 COMMISSIONING

A. Refer to General Commissioning Requirements in Division 01 for additional requirements.

1.34 TEMPORARY HEATING AND COOLING

A. Refer to the General Conditions of the Contract for Construction and Supplemental General Conditions.

1.35 MAINTENANCE OF HVAC SYSTEMS DURING TEMPORARY USE PERIODS

A. Provide each air handling system with a set of prefilters in addition to the permanent filters. Furnish four sets of prefilters for each system for use when system is operated for temporary heating or cooling. During such use, change prefilters as often as directed by Owner's Representative. Provide MERV-8 filters in all open ended ducts, return grilles and registers to keep dust out of ductwork. Change as often as necessary. Remove all such temporary filters upon completion. Use supply fans only. Do not operate return fans.

B. Blank-off outside air intake opening during temporary heating period. Install first set of permanent filters and prefilters.

C. Adjust dampers on supply system.

D. Set all heating coil control valves for manual operation.

E. Do not install any grilles or diffusers at room terminal ends of ducts until permission is given.

F. Assume responsibility for systems and equipment at all times, even though used for temporary heat or ventilating. Repair or replace all dented, scratched or damaged parts of systems prior to final acceptance.

G. Remove concrete, rust, paint spots, other blemishes, then clean.

H. Just prior to final acceptance, remove used final filter and install new set. Deliver all unused sets of prefilters to the Owner and obtain written receipt. Properly lubricate system bearings before and during temporary use. Maintain thermostats, freeze stats, overload devices, and all other safety controls in operating condition.

1.36 TEMPORARY FACILITIES

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.37 TEMPORARY LIGHT AND POWER

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.38 CLEANING

A. It is the Contractor's responsibility to keep clean all equipment and fixtures provided under this contract for the duration of the project. Each trade shall keep the premises free from an accumulation of waste material or rubbish caused by his operations. The facilities require an environment of extreme cleanliness, and it is the Contractor's responsibility to adhere to the strict regulations regarding procedures on the existing premises. After all tests are made and installations completed satisfactorily:

1. Thoroughly clean entire installation, both exposed surfaces and interiors.

2. Remove all debris caused by work.

3. Remove tools, surplus, materials, when work is finally accepted.

1.39 SYSTEM START-UP AND TESTING

A. Prior to commencement of work, the Division(s) effecting such system shall survey all building mechanical, plumbing, fire protection and electrical systems and components and make written notice to the Owner's Representative regarding any damage, missing items and/or incomplete systems. Prior to the conclusion of this project, the Contractor shall verify with the Owner's Representative that all building systems have been returned to their original conditions.

1.40 TRANSFER OF ELECTRONIC FILES

A. M/E Engineering, P.C. will provide electronic files for the Contractor's use in the preparation of sheetmetal shop drawings, coordination drawings, or record drawings related to the project, subject to a and the following terms and conditions:

1. The Contractor shall submit a formal request for electronic drawing files on the M/E Engineering, P.C. website, by utilizing the following website link: http://www.meengineering.com/contact-pages/contractor-request.

2. M/E Engineering, P.C. makes no representation as to the compatibility of these files with the Contractor's hardware or the Contractor's software beyond the specific release of the referenced specifications.

3. M/E Engineering, P.C. can only provide CAD files of M/E/P/FP drawing levels for which we are the Engineer of Record. CAD files of Architectural backgrounds, reflected ceiling plans, structural plans, etc. must be obtained separately from the Architect of Record.

4. Data contained on these electronic files is part of M/E Engineering, P.C.'s instruments of service shall not be used by the Contractor or anyone else receiving data through or from the Contractor for any purpose other than as convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by the Contractor or by others will be at the Contractor's sole risk and without liability or legal exposure to M/E Engineering, P.C. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against M/E

Engineering, P.C., its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with the Contractor's use of the electronic files.

5. Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless, M/E Engineering, P.C. from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from the Contractor's use of these electronic files.

6. These electronic files are not contract documents. Significant difference may arise between these electronic files and corresponding hard copy contract documents due to addenda, change orders or other revisions. M/E Engineering, P.C. makes no representation regarding the accuracy or completeness of the electronic files the Contractor receives. In the event that a conflict arises between the signed contract documents prepared by M/E Engineering, P.C. and electronic files, the signed contract documents shall govern. The Contractor is responsible for determining if any conflicts exist. By the Contractor's use of these electronic files the Contractor is not relieved of the Contractor's duty to comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, field verify conditions and coordinate the Contractor's work with that of other contractors for the project.

1.41 ENERGY INCENTIVES

A. The Contractor, his Subcontractors and Suppliers shall provide to the Owner all paperwork necessary to support the Owners pursuit of incentives related to energy conservation as offered by the utility company or state sponsored incentive programs. This shall include at a minimum, receipts, and quantities and data sheets for energy efficient equipment such as: lighting, motors, variable frequency drives, etc.

END OF SECTION

SECTION 210523 - VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Document.

1.2 SUBMITTALS

A. Submit manufacturer's data in accordance with Basic Mechanical/Electrical Requirements. Obtain approval prior to ordering material.

B. Provide submittals for all items specified under Part 2 of this section.

PART 2 - PRODUCTS

2.1 VALVES

A. General: Valves shall have the following requirements:

1. Working pressure stamped or cast on bodies.

2. Stem packing serviceable without removing valve from line.

3. UL listed and FM approved and labeled for intended fire protection service. Sprinkler systems 175 WWP; stamped/cast on body.

B. Acceptable Manufacturers:

1. Gate Valves: Kennedy, Mueller, Nibco, Stockham, Victaulic.

2. Butterfly/Ball Valves, Indicating Type: Grinnell, Kennedy, Milwaukee, Stockham, Victaulic.

3. Check Valves: Grinnell, Kennedy, Nibco, Stockham, Victaulic.

2.2 GATE VALVES

A. 2-1/2 in. and Larger: IBBM, resilient wedge disc, OS&Y, flanged ends, stems grooved for tamper switch, 200 WWP; Stockham Fig. G-610.

B. 2 in. and Smaller: Bronze body and bonnet, OS&Y, threaded ends, solid wedge, 175 WWP; Stockham Fig. B-133.

2.3 BUTTERFLY/BALL VALVE

A. 2-1/2 in. and Larger: Butterfly style, ductile iron body, lug type, aluminum bronze disc, stainless steel trim, EPDM seat, bubbletight shutoff, suitable for dead end service, gear operator, provision to tamper switch, 200 WWP; Stockham #LD-72UF.

B. 2 in. and Smaller: Bronze body, threaded ends; indicating gear operator, provision for tamper switch; Milwaukee "Butterball".

2.4 CHECK VALVES

A. 2-1/2 in. and Larger: IBBM, swing type, rubber faced disc, bolted flange cap, flanged ends; Stockham #G-940.

B. 2 in. and Smaller: Bronze body, swing type, rubber faced, threaded ends; Grinnell #3315.

2.5 PRESSURE REDUCING VALVES

A. Ductile iron body construction, nylon reinforced diaphragm, nylon reinforced brass and stainless steel pilot valve, integral strainer, pressure relief valve, adjustable pressure range.

B. Valve shall be UL listed and FM approved.

C. Design Equipment: Tyco Model PRV-1.

D. Acceptable Manufacturers: Cla-Val, Tyco, Viking.

2.6 MISCELLANEOUS

A. Trim and Test Valves: Ball, plug, angle or globe type; bronze body; threaded ends; UL listed.

1. Ball Valves: Bronze two-piece body, full port, threaded ends, chrome plated ball, blowout proof stem, reinforced TFE seats, 300 psi working pressure, UL listed, FM approved; Nibco Model KT-585-70-UL.

B. Hose Thread Drain Valves:

1. Ball Valve: Bronze body, hardened chrome ball with hose thread end, cap and chain; Watts #B6001CC (sweat connection), Watts #B6000CC (threaded connection).

2.7 UNDERGROUND VALVES AND ACCESSORIES

A. Gate Valves 2 in and larger: IBBM, inside screw-in, wedge disc, resilient seat, "O" ring seals, 175 WWP, open counter-clockwise, 2 in. square wrench nut, mechanical joint ends, AWWA C509: Kennedy Ken Seal Fig. #4571

B. Valve Boxes: Cast iron adjustable screw type box and cover extending from the valve to finish grade. Cast arrow and lettering on cover of box denoting direction of valve opening and service. Provide with each curb valve.

C. Valve Key: Steel socket key for gate valve or curb valves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide all shutoff, check, drain and other type valves as required by Code as indicated and as required for proper system maintenance, isolation and safety.

B. Locate valves for easy access and provide separate support where necessary. Install valves with stems at or above the horizontal position. Install swing check valves in horizontal position with hinge pin level.

C. Provide hose thread drain valves at all low points to enable complete drainage of all portions of the system.

D. For underground valves: Valve boxes shall be placed vertically over each valve, and the top of the box adjusted to proper grade, and the valve and box immediately backfilled with crushed stone carefully tamped into place. Valves shall be checked for proper operation before installation and, unless otherwise instructed are to be left in the open position.

E. Install valves per respective listing/approval.

F. Use 250 WWP, FM approved anti-water hammer check valves at discharge and bypass of fire pumps, otherwise use swing type.

G. Use ball valves for auxiliary drains and inspector test valves on dry pipe and pre-action systems.

END OF SECTION

SECTION 210553 - FIRE PROTECTION IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services as required for the complete installation designed in Contract Documents.

1.2 QUALIFICATIONS

A. All identification devices shall comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles.

1.3 SUBMITTALS

A. Submit manufacturer's technical product data and installation instructions for each identification material and device. Submit valve schedule for each piping system typewritten on an 8-1/2 in. x 11 in. paper (minimum), indicating code number, location and valve function. Submit schedule of pipe, equipment and name identification for review before labeling.

1.4 ACCEPTABLE MANUFACTURERS

A. Allen Systems, Inc., Brady (W.H.) Co.; Signmark Div., Emedco, Industrial Safety Supply Co., Inc., Lab Safety Supply, Seton Name Plate Corp.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide manufacturer's standard products of categories and types required for each application. In cases where there is more than one type specified for an application, selection is installer's option, but provide single selection for each product category.

B. All adhesives used for labels in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits as called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

2.2 PIPING IDENTIFICATION

A. Identification Types:

1. Snap-on type: Provide manufacturer's standard pre-printed, semi rigid snap-on, color coded pipe markers, complying with ANSI-A13.1.

2. Pressure sensitive type: Provide manufacturer's standard pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers complying with ANSI A13.1. Provide a 360° wrap of flow arrow tape at each end of pipe label.

B. Lettering:

1. Piping labeling shall conform to the following list:

PIPE FUNCTION	IDENTIFICATION
Fire Protection Water	FIRE PROTECTION WATER
Fire Sprinkler Water	FIRE SPRINKLER WATER

2.3 VALVE IDENTIFICATION

A. Valve Tags:

1. Standard brass valve tags, 2 in. diameter with 1/2 in. high black-filled numerals. Attach to valve with brass jack chain and "S" hook. Identify between fire protection, heating and plumbing services with 1/4 in. letters above the valve number.

2. Equal to Seton Style No. M4507.

B. Provide a sign for each control, sectional and drain valve identifying the portion of the building served in accordance with NFPA 13Valve Chart:

1. Provide valve chart for all valves provided as a part of this project. Frame and place under clear glass. Mount in Mechanical Room.

2.4 ABOVE CEILING EQUIPMENT LOCATOR

A. 3/4 in. diameter adhesive stickers placed on ceiling grid and color-coded.

B. The color for all fire protection valves shall be RED.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide valve tags for all valves provided on project.

B. Provide piping identification with directional flow arrows for all piping on project, maximum every 20'-0" or piping installed through rooms, provide at least one pipe label in each room, for each pipe function.

C. Provide equipment tags for all equipment provided.

END OF SECTION

SECTION 211010 - PIPING SYSTEMS AND ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUBMITTALS

A. Provide a schedule of pipe materials, fittings and connections.

B. Provide a detailed matrix listing the specific UL approved firestop system assembly to be used for each type of piping provided and each type of construction to be penetrated along with all associated UL assembly details.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pipe and fittings shall be new, marked with manufacturer's name and comply with applicable ASTM and ANSI Standards.

2.2 STEEL PIPING AND FITTINGS

A. Pipe: ASTM A53, or ASTM A106 seamless, Schedule 40 weight; black finish as called for; ends chamfered for welding or grooved for grooved mechanical connections.

B. Fittings: Same material and pressure class as adjoining pipe.

1. Welded Fittings: Factory forged, seamless construction, butt weld type chamfered ends. Where branch connections are two or more sizes smaller than main size, use of "Weldolets", "Thredolets" or "Sockolets" acceptable. Mitered elbows, "shaped" nipples, and job fabricated reductions not acceptable unless specifically called for. Socket weld type, 2000 psi wp, where called for.

2. Threaded Fittings: Class 125, cast or malleable iron, black, as called for; UL listed and FM approved for fire protection systems. Street type 45° and 90° elbows are not acceptable.

C. Flanges, Unions, and Couplings:

1. Threaded Connections:

a. Flanges: Cast iron companion type; for sizes 2-1/2 in. and larger.

b. Unions: Malleable iron, bronze to iron seat, 300 lb. wwp; for sizes 2 in. and smaller.

c. Couplings: Malleable iron. Steel thread protectors are not acceptable as couplings.

2. Welded Connections:

a. Flanges: Welding neck type. Slip-on type not allowed unless noted and shall not be installed in conjunction with butterfly valves.

3. Grooved Mechanical Connections:

a. Couplings: Ductile iron, ASTM A395 and ASTM A536, with painted coating, designed for rolled grooved piping, hot dipped galvanized finish complying with ASTM A153 where called for.

b. Gaskets: Grade "E" EPDM synthetic rubber, -30°F to 230°F temperature range, suitable for water service.

c. Bolts and Nuts: Heat treated, hex head carbon steel, ASTM A183, cadmium plated or zinc electroplated.

d. Fittings: Elbows, tees, laterals, reducers, adapters as required shall be **f**abricated from carbon steel pipe conforming to ASTM A53. Fittings shall have grooves designed to accept grooved end couplings of the same manufacturer.

e. Victaulic, rigid system, Style 005 couplings cast with offsetting angle pattern bolt pads to provide system rigidity and support in accordance with ANSI B31.1 and B 31.9. UL listed and FM approved; 300 psi wwp; follow all terms of listings/approvals.

f. Acceptable Manufacturers: Grinnell, Gruvlok by Anvil, Victaulic or approved equal.

D. Gauge and Instrument Connections: Nipples and plugs for adapting gauges and instruments to piping system shall be IPS brass.

E. Base Elbows:

1. Cast iron or steel type, flange connections; Crane 500 or equivalent made from welding elbows, with welded pipe support and steel base. Reducing elbows where necessary.

ELBOW SIZE	SUPPORT SIZE	BASE PLATE
4 in. to 6 in.	2-1/2 in.	8 in. x 8 in. x 1/4 in.

2. Anchor bolt holes in each corner of base for securely bolting to floor or concrete base; minimum 3/4 in. bolts.

2.3 DIELECTRIC PIPE FITTINGS

A. Description: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

B. Unions: Factory fabricated, for 250 psi minimum working pressure at 180°F, threaded or solder ends, insulating material suitable for system fluid, pressure and temperature.

C. Flanges: Factory fabricated, companion flange assembly, for 150 or 300 psig minimum pressure to suit system fluid pressures and temperatures with flange insulation kits and bolt sleeves.

D. Acceptable Manufacturers: EPCO, Capitol Manufacturing, Victaulic, Watts or approved equal.

2.4 HANGERS, INSERTS AND SUPPORTS

A. Hangers, Inserts, Clamps: B-Line, Grinnell, Michigan Hanger, PHD Manufacturing.

B. Hangers:

1. Adjustable, wrought malleable iron or steel with electroplated zinc or cadmium finish. Copper plated or PVC coated where in contact with copper piping. Hot-dipped galvanized finish for exterior locations.

2. Adjustable ring type where piping is installed directly on hanger for piping 3 in. and smaller.

3. Adjustable steel clevis type for piping 4 in. and larger.

4. Nuts, washers and rods with electroplated zinc or cadmium finish. Hot-dipped galvanized finish for exterior locations.

C. Spacing Schedule (Maximum Distance between Hangers (ft.-in.):

NOMINAL PIPE SIZE (IN.)	**3/4**	**1**	**1-1/4**	**1-1/2**	**2**	**2-1/2**	**3**	**3-1/2**	**4**
Steel Pipe	N/A	12-0	12-0	15-0	15-0	15-0	15-0	15-0	15-0
Rod Size (in.)	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8

D. Beam Attachments:

1. C-Clamp style, locknut, restraining strap, electroplated finish, UL listed, FM approved for pipe sizes 2 in. and smaller, complying with NFPA 13.

2. Center loaded style with clamp attachments that engage both edges of beam, electroplated finish, UL listed, FM approved, for pipe sizes larger than 2 in., refer to "Supports" for additional requirements, complying with NFPA 13.

E. Inserts: Carbon steel body and square insert nut, galvanized finish, maximum loading 1300 lbs., for 3/8 in. to 3/4 in. rod sizes, reinforcing rods on both sides, MSS-SP-69 Type 19 or approved equal, complying with NFPA 13.

F. Supports:

1. For all piping larger than 2 in., provide intermediate structural steel members for hanger attachment. Members shall span across the bar joists at panel points of joists. Secure member to structure. Select size of members based on a minimum factor of safety of four.

2. For weights under 1,000 lbs.: "Drill-In" inserts, "U" shaped Channel, beam clamps or other structurally reviewed support. The factor of safety shall be at least four. Follow manufacturer's recommendations.

3. For Metal Decks: Drill hole through for hanger rods and imbed a welded plate in concrete or use devices designed for this application, with a safety factor of four.

4. Acceptable Manufacturers: Hilti, ITW Ramset, Phillips "Red Head" or approved equal.

G. Hangers for fire protection piping as specified and in accordance with NFPA 13 and NFPA 14. Hangers and building attachments shall be UL listed and FM approved for fire protection service. Adjustable swivel ring type hangers are permitted for 3 in. and smaller piping.

2.5 PIPING ACCESSORIES

A. Escutcheon Plates: Steel or cast brass, split hinge type with setscrew, high plates where required for extended sleeves. Chrome plated in finished areas.

B. All bushings and nipples required for instruments and gauges shall be brass.

2.6 SLEEVES

A. Standard Type:

1. Schedule 40 black steel pipe sleeves for structural surfaces, two (2) pipe sizes larger than the pipe, and as recommended by the sealing element manufacturer. Provide full circle water stop collar for sleeves located within below grade walls, wet wells and waterproofed surfaces. The collar shall be fabricated from steel plate and welded to the sleeve around its entire circumference.

2. Schedule 40 PVC sleeves or sheet metal sleeves for nonstructural surfaces and existing construction. Sheet metal sleeves shall be 18 gauge minimum and braced to prevent collapsing.

2.7 SEALING ELEMENTS

A. Expanding neoprene link type, watertight seal consisting of interlocking links with zinc plated bolts.

1. Acceptable Manufacturers: Thunderline "Link-Seal" Series 200, 300 or 400, Pyropac, Calipco.

2.8 FIRESTOP SYSTEM FOR OPENINGS THROUGH FIRE RATED WALL AND FLOOR ASSEMBLIES

A. Materials for firestopping seals shall be listed by an approved independent testing laboratory for "Through-Penetration Firestop Systems". The system shall meet the standard fire test for Through-Penetration Firestop Systems designated ASTM E814. Firestop system seals shall be provided at locations where piping pass through fire rated wall, floor/ceiling, or ceiling/roof assembly. Minimum required fire resistant ratings of the assembly shall be maintained by the Firestop System. Installation shall conform to the manufacturer's recommendations and other requirements necessary to meet the testing laboratory's listing for the specific installation.

2.9 PIPING MATERIALS AND SCHEDULE

A. See Exhibit "A" - Piping Materials at end of this Section for Fire Protection piping.

B. See Exhibit "B" - Testing at end of this Section for Fire Protection piping.

PART 3 - EXECUTION

3.1 EQUIPMENT AND SYSTEMS

A. Install equipment and systems in accordance with provisions of each applicable section of these Specifications, and Local/State Codes/Regulations having jurisdiction. Accurately establish grade and elevation of piping before setting sleeves. Install piping without springing or forcing, except where specifically called for, making proper allowance for expansion and anchoring. Changes in size shall be made with reducing fittings. Reducing couplings are not acceptable. Arrange piping at equipment with necessary offsets, unions, flanges, and valves, to allow for easy part removal and maintenance. Offset piping and change elevation as required, to coordinate with other work. Avoid contact with other mechanical or electrical systems. Provide adequate means of draining and venting systems. Conceal piping unless otherwise called for.

B. Cap or plug equipment and pipe openings during construction. Install piping parallel with lines of building, properly spaced to provide clearance for insulation. Make changes in direction and branch connections with fittings. Do not install valves, unions and flanges in inaccessible locations. Materials within a system and between systems shall be consistent. If this is not possible, install dielectric fittings.

3.2 PIPING OVER ELECTRICAL EQUIPMENT

A. Contractor shall route piping to avoid installation directly over electric equipment, including, but not limited to panels, transformers, disconnects, starters, motor control center, adjustable speed drives and fused switches.

B. Piping shall not be installed in the dedicated electric and working space as defined by NEC 110. Dedicated electrical space is generally equal to the depth and width of electrical equipment, and extends 6 ft. above the electrical equipment, or to a structural ceiling. Dedicated working space is a minimum of 30 in. wide or the width of equipment (whichever is larger) a minimum of 6 ft.-6 in. tall, with a depth of 3ft. to 9 ft. depending on the voltage.

3.3 HANGERS, INSERTS AND SUPPORTS

A. Piping shall not be supported by wires, band iron, chains, from other piping, or by vertical expansion bolts. Support piping with individual hangers from concrete inserts, wood construction, welded supports, or beam clamps of proper configuration and loading design requirements for each location; replace if not suitable. Follow manufacturer's safe loading recommendations. Suspend with rods of sufficient length for swing and of size called for, using four (4) nuts per rod. Provide additional structural steel members, having one coat rustproof paint, where required for proper support. Provide oversized hangers on diesel engine exhaust piping where insulation/supports must pass between pipe and hanger. Hangers, when attached to joists, shall only be placed at the top or bottom chord panel point. Only concentric type hangers are permissible on piping larger than 2-1/2 in.; "C" types are permitted for piping 2 in. and smaller on joists. Provide riser clamps for each riser at each floor.

3.4 PIPE CONNECTIONS

A. Threaded Connections: Clean out tapering threads, made up with pipe dope; screwed until tight connection. Pipe dope must be specifically selected for each application.

B. Grooved Mechanical Joints: Pipes joined with grooved fittings shall be joined by a listed combination of fittings, couplings, gaskets and grooves of a single manufacturer. Lubricate and install gasket and couplings. Follow manufacturer's recommendations. Grooved ends shall be clean and free of indentations, projections and roll marks in the area from pipe end to groove.

C. Dielectric Pipe Fittings: Protect fittings from excessive heat.

3.5 WELDING

A. Welding shall be performed in compliance with the welding procedure specifications prepared by the National Certified Pipe Welding Bureau. Welded piping fabricated by qualified welder. Use certified welder where specifically required by code or insurance company. If indicated and permitted for fire protection systems, all provisions for welded pipe shall additionally be in accordance with NFPA Standard 13. Use full length pipe where possible; minimum distance between welds, 18 in. on straight runs. Welds must be at least full thickness of pipe with inside smooth and remove cutting beads, slag and excess material at joints; chamfer ends. Minimum gap 1/8 in., maximum 1/4 in., for butt welds. Overlaps on position and bench welds to be not less than 3/4 in. One internal pass and one external pass minimum required on slip-on flanges. Do not apply heat to rectify distorted pipe due to concentrated welding; replace distorted pipe.

3.6 SLEEVES

A. Provide for pipes passing through floors, walls or ceilings. Not required for floors that are core-drilled, except where floor is waterproofed. Extend 1/8 in. above finished floor in finished areas. In above grade Mechanical Rooms and other areas with floor drains use steel pipe sleeves 2 in. above floor. Use steel pipe sleeves in bearing wall, structural slabs, beams and other structural surfaces, and where called for. Sleeves shall be as small as practical, consistent with insulation, so as to preserve fire rating. Fill abandoned

sleeves with concrete. Provide rubber grommet seals for pipes passing through ducts or air chambers or built-up housings.

3.7 SLEEVE PACKING

A. Seal void space at sleeves as follows:

1. Interior locations: Firmly pack with fiberglass and caulk.

2. Exterior walls above grade: Use sealing element.

3. Exterior walls below grade and above floors: Use sealing element.

4. Cored holes: Use sealing element.

5. Fire rated, partitions and floor slabs: Use fire rated sealing elements, materials and methods. Provide per manufacturer's instructions to maintain firestop.

6. Waterproofed walls/floors: Use waterproof sealing element, device or compound.

3.8 ESCUTCHEON PLATES

A. Provide polished chrome setscrew type escutcheon plates for all exposed piping passing through floors, walls or ceilings, in all rooms except in Boiler, Fan and Mechanical Rooms.

3.9 TESTS

A. Fire suppression systems shall be hydrostatically tested at 200 psi for two (2) hours in accordance with NFPA 13.

B. Provide all necessary items to complete proper testing of work. Perform all testing in accordance with governing Codes, local utilities and other agencies having jurisdiction and as specified. Pay all costs to perform tests. Perform all testing in a safe manner. Isolate existing systems.

3.10 PIPE LINE SIZING

A. Pipe sizes called for are to be maintained. Pipe size changes made only as reviewed by Owner's Representative and shall be justified by hydraulic calculations. Where discrepancy in size occurs, the larger size shall be provided.

EXHIBIT "A" - PIPING MATERIALS

SERVICE	PIPE MATERIALS	FITTINGS	CONNECTIONS
Fire service	SEE "UNDERGROUND PIPING AND ACCESSORIES" SECTION 221020		
Sprinkler (wet)	Schedule 40, black steel, 4 in. and smaller	Cast or malleable iron	Threaded

EXHIBIT "B" - TESTING

SERVICE	TEST REQUIREMENTS
Sprinklers	Test hydrostatically at 200 psi for two (2) hours in accordance with NFPA 13.

END OF SECTION

SECTION 211300 - FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

B. Wet pipe sprinkler system to be provided throughout new building. All spaces are required to be covered with sprinkler heads per NFPA 13 requirements and New York State Building and Fire Codes for a Type "I" institutional occupancy. Attic spaces will require full sprinkler coverage as required.

C. Fire Protection/Sprinkler system requirements and installation for this project are performance base per this specification design criteria. Fire Protection/Sprinkler contractor will be required to provide the following:

1. Flow test and flow test data of the existing municipal water main being the source of the fire water service line (4").

2. Hydraulic Calculations and associated "shop" installation plans for complete building system layout.

3. Complete Sprinkler system installation from the 4" water source. Include service riser, 4" alarm check valve, floor control valves (tamper, flow switch, drain), alarm devices for valves and flow indication. Include Horn/strobe type device for water flow alarm, mounted on exterior above/adjacent to FDC.

4. Fire Department Connection (FDC). Exterior connection / Inlet type per local Fire Department requirements.

5. "As-Built" sprinkler plans for final close out documentation.

6. Areas subject to freezing including unheated attic spaces to be protected with an auxillary dry pipe sprinkler system with a dry pipe riser and air compressor located at main 4" water service entrance.

1.2 QUALITY ASSURANCE

A. Comply with the 2020 Fire Code of New York State referenced edition of the following National Fire Protection Association (NFPA) Standards:

1. NFPA 13: Standard for the Installation of Sprinkler Systems.

2. NFPA 24: Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

3. NFPA 25: Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

4. NFPA 72: National Fire Alarm Code.

B. Follow all requirements, recommendations and appendices to comply with the latest edition of the following publications, codes, standards, and listings/approvals:

1. Factory Mutual Engineering Corporation (FM) Approval Guide.

2. Underwriters Laboratories, Inc. (UL) Fire Protection Equipment Directory.

3. 2020 Fire Code of New York State.

4. OSHA Rules and Regulations.

5. Requirements of Insurance Underwriter and other Authorities Having Jurisdiction.

C. Equipment, devices, hangers and components shall be UL listed and FM approved and labeled for the intended fire protection service.

D. The fire protection work shall be performed by an experienced firm regularly engaged in the installation of fire protection sprinkler systems.

E. Preparation of working plans, calculations and site observation of systems shall be completed by a NICET Level III technician under the direction of a qualified New York State Registered Professional Engineer.

1.3 SYSTEM DESCRIPTION

A. The fire protection system shall be a wet pipe automatic sprinkler system arranged to properly protect all spaces.

B. Water is supplied from an unknown size / TBD. Municipal water main located in West Clarkstown Road, through a 4 in. underground water main to the system's main riser. Water supply data / flow test at the municipal main needs to indicate the following:

1. X psi static.

2. X psi residual with X gpm flowing.

C. The residual hydrant is located at West Clarkstown Road with the flow hydrant located at West Clarkstown Road. This contractor shall arrange for a new flow test on the municipal main prior to performing hydraulic calculations. Fire department connection(s) shall be provided to allow the servicing fire department to augment the system's normal automatic water supply.

D. The system shall be hydraulically calculated in accordance with all provisions of the Contract Documents and any Authority Having Jurisdiction.

E. Calculations shall be based upon the specific hazard for the areas being protected. The following minimum requirements shall be provided as actually installed in the protected spaces.

1. Light hazard: These areas shall include: All occupied rooms.

    a. Water density: 0.10 gpm/sq. ft.

    b. Maximum coverage per sprinkler = 168 sq. ft.

    c. Hydraulic remote area: 1500 sq. ft.

    d. Interior hose demand: 100 gpm.

2. Ordinary Hazard Group 1: These areas shall include: Mechanical Rooms and Attic Space.

    a. Water density: 0.15 gpm/sq. ft.

    b. Maximum coverage per sprinkler = 130 sq. ft.

    c. Hydraulic remote area: 1500 sq. ft.

    d. Interior hose demand: 100 gpm.

F. Maximum coverage for any sprinkler head shall not exceed NFPA requirements and the listing for the sprinklers provided.

G. A minimum 10 psi safety factor shall be provided between the available municipal water supply curve and the total system demand point. The total system demand point shall be at the municipal water main and include the calculated sprinkler and interior hose stream demands plus the exterior hose stream demand at the residual pressure required for proper system operation.

H. The maximum flow velocity shall not exceed 20 ft. per second in the piping system and 15 ft. per second in mains with paddle type waterflow indicators.

I. Water supply control valves shall be electrically supervised and mechanically locked for proper position. Waterflow and supervisory circuits shall be in accordance with the requirements of electrical specifications. Electric connections to sprinkler system shall be by Division 26. Furnish wiring diagrams for all equipment.

J. Provide 3/16 in. x 1 in. cadmium plated carbon steel chains and master keyed all brass case hardened padlocks to lock water supply valves in the proper position.

1.4 SUBMITTALS

A. Product Data:

1. Submit manufacturer's catalog cut, specifications and installation instructions for each item or component of fire protection system. Clearly indicate pertinent information such as, but not limited to:

    a. Manufacturer's model number.

    b. Materials, size, finish and type of connection.

c. Pressure ratings of components.

d. FM approval/UL listing.

B. Certification: Submit Contractor's NICET certification and number.

C. Samples:

1. If requested, submit sample of sprinklers.

D. Drawings and Calculations:

1. All drawings and calculations shall be signed and sealed by a New York State Registered Professional Engineer.

2. Submit complete NFPA 13 drawings and hydraulic calculations with cross reference to applicable drawings, water supply data, and equipment schedule with ratings for the system to the Owner's Representative, Insurance Underwriter, and other Authorities Having Jurisdiction.

3. Submit hydraulic calculations for each design density/remote area with items in NFPA 13 incorporated including sketches to indicate flow quantities, sprinklers operating and direction of flow for pipes in looped and gridded systems.

4. Drawing shall be fabrication drawings provided to indicate actual sprinkler, and equipment layouts. Drawings shall be 1/4" = 1'-0" scale on reproducible sheets of uniform size. Drawings shall show all data required by NFPA 13.

5. Submit drawings in one (1) complete package.

E. Record Drawings and Documents:

1. Submit Record Drawings, hydraulic calculations, test reports, and NFPA Above and Below Ground Material and Test Certificates to the Owner's Representative, Insurance Underwriter and other Authorities Having Jurisdiction.

PART 2 - PRODUCTS

2.1 GENERAL

A. Mixing of manufacturers or models of the same or similar component will not be acceptable.

2.2 FIRE DEPARTMENT CONNECTION

A. Cast brass; straight or angle body as required; two-way lug swivel inlets with individual drop clappers; cast brass; raised letter escutcheon labeled "AUTOSPKR"; matching brass plugs and chains.

1. 2-1/2 in. x 2-1/2 in. x 4 in. Or Storz type. Confirm type with local Fire Department.

2. 2-1/2 in. hose threads shall match those in use by the local Fire Department.

3. Polished brass escutcheon, inlets, plugs, and chains.

4. Design Equipment:

a. Horizontal Flush Wall Type: Potter-Roemer 5020 Series.

B. Storz quick connect type with 30 degree elbow, cap, chain and escutcheon labeled "AUTOSPKR".

1. 4 in. Storz x 4 in. NPT.

2. Polished brass escutcheon, inlets, plugs and chains.

3. Design Equipment: Potter-Roemer Fig. No. 5795-01 connection with Fig. No. 5799-01 cap and chain.

C. Acceptable Manufacturers: Badger-Powhatan, Croker, Elkhart, Potter-Roemer.

2.3 PRESSURE GAUGES

A. Water Pressure Gauge:

1. Anodized aluminum case, 3-1/2 in. diameter, glass lens, brass movement, 1/4 in. NPT male bottom connection with gauge cock.

2. 0 to 300 psi range, in 5 psi increments with accuracy to meet ANSI B40.1.

B. Air Pressure Gauge:

1. Anodized aluminum case, 3-1/2 in. diameter, glass lens, brass movement, 1/4 in. NPT male bottom connection with gauge cock.

2. 0 to 80 psi range, in 1 psi increments with accuracy to meet ANSI B40.1.

2.4 SPRINKLER EQUIPMENT

A. Alarm Check Valve: Vertical style with grooved ends, cast iron body, replaceable clapper facing, right or left hand alarm trim for variable pressure operation.

1. Trim:

a. Main drain and valve.

b. Gauges with gauge cocks.

c. Galvanized pipe and trim fittings.

d. Retard chamber and pressure switch.

e. Horn/Strobe flow device.

2. Design Equipment: Reliable Model E (175 psi**)**.

3. Acceptable Manufacturers: Reliable, Tyco, Victaulic, Viking.

B. Riser Check Valve: Vertical style, grooved end, cast iron body and stainless steel clapper with replaceable facing.

1. Trim:

a. Main drain and valve.

b. Gauges with gauge cocks.

c. Galvanized pipe and trim fittings.

2. Design Equipment: Reliable Model G (250 psi).

3. Acceptable Manufacturers: Reliable, Tyco, Victaulic, Viking.

C. Dry Pipe Valve: Vertical style with grooved ends, cast iron body, replaceable clapper facing with right or left hand trim and controls for automatic operation.

1. Trim:

a. Main drain and valve.

b. Gauges with gauge cocks.

c. Galvanized pipe and trim fittings.

d. Low air and waterflow alarm switches.

e. Automatic air pressure maintenance device.

f. Air relief valve set at 5 psi in excess of maximum pressure that should be on system.

g. Horn/Strobe Flow Device.

h. Anti-flooding type accelerator with trimmings.

2. Design Equipment: Reliable Model D 4 in.

3. Acceptable Manufacturers: Reliable, Tyco, Victaulic, Viking.

D. Air Compressor - Riser Mounted Type: Direct drive, air cooled, single stage, oil less compressor, air filter, safety relief valve, field adjustable pressure range,1/3 HP, 120 volt, 1 phase electric motor, mounting bracket, sized to pump system to 40 psi in less than 30 minutes, with air maintenance device.

1. Design Equipment: Reliable Model A.

2. Acceptable Manufacturers: General, Reliable, Viking.

2.5 SPRINKLERS AND ACCESSORIES

A. Brass or bronze, 1/2 in. orifice, 1/2 in. NPT. 165°F ordinary temperature classification for light and ordinary hazards. Use 286°F sprinklers in Mechanical, Electrical and Elevator Rooms; in vicinity of heat equipment/sources; and in accordance with NFPA 13.

1. Finished Ceiling Areas: White finish sprinklers Concealed pendent sprinklers with matching coverplate, color white.

2. Unfinished Ceiling Areas: Natural brass/bronze finish pendent or upright sprinklers as required.

B. Sprinkler Types and Design Equipment:

1. Quick Response Upright: Reliable Model F1FR.

2. Quick Response Concealed Pendent: Reliable Model G4A.

3. Quick Response Horizontal Sidewall: Reliable Model F1FR-HSW1.

4. Quick Response Dry Pendent and Horizontal Sidewall: Reliable Model F3QR.

5. Attic Sprinklers: Tyco Model BB (Back-to-Back), SD (Single Directional), HIP, AP Attic Plus.

C. Flexible Sprinkler Drops:

1. FM Approved braided Type 304 stainless steel tube with union joints, factory tested to 400 psi and listed for up to three (3) 90° bends including bracket for mounting to ceiling or building structure.

a. Design Equipment: Victaulic "VicFlex".

D. Sprinkler Cabinets and Spare Sprinklers:

1. Steel or aluminum construction with shelves and shell holes to accommodate the number of spare sprinklers required by NFPA 13.

2. Bright red finish with hinged front door and label.

3. Sprinkler wrenches compatible for each type used.

4. Spare sprinklers for each system of the type and proportion of those used in each system.

5. Design Equipment: Reliable Model A-4.

E. Acceptable Manufacturers: Reliable, Tyco, Victaulic, Viking.

2.6 ALARM EQUIPMENT

A. Waterflow Pressure Switch:

1. Pressure activated waterflow alarm switch with retard, steel enclosure and cover, adjustable differential type, SPDT contacts, 24 volt DC, 1/2 in. pressure connection, 250 psi rated.

2. Design Equipment: Potter Electric #WFSR-F.

B. Air Pressure Supervisory Switch:

1. For remote low air pressure supervisory alarm and for air compressor operation, steel enclosure and cover, adjustable differential type, SPDT contacts, 24 volt DC, 1/2 in. pressure connection compatible with system devices, 250 psi rated.

2. Design Equipment: Potter Electric #PS40A.

C. Paddle Waterflow Detectors:

1. Adjustable retard feature, SPDT contacts, 24 volt DC, 250 psi rated.

2. Design Equipment: Potter Electric #VSR Series.

D. Tamper Switches:

1. Integral with valve or separate device installed on valve to actuate alarm upon valve movement, steel enclosure, SPDT contacts, 24 volt DC, mounting brackets and hardware.

2. Design Equipment: Potter Electric #OSYSU (for OS&Y valves) and #PIVSU-A (for post indicator and butterfly valves).

E. Acceptable Manufacturers: Autocall, Potter Electric, System Sensor.

2.7 INSPECTOR'S TEST EQUIPMENT

A. Test and Drain Valve:

1. Combined test and drain valves, sight glass and interchangeable restricting orifice, sized for smallest orifice in sprinkler zone.

2. Design Equipment: AGF Manufacturing "Test and Drain".

3. Acceptable Manufacturers: AGF Manufacturing, Viking, Victaulic.

2.8 MANUAL AIR VENTS

A. Manual air vent shall include 1 in. isolation valve with forged brass body, stainless steel 20 mesh strainer, ball float, hose connection, threaded cap and lanyard.

1. Design Equipment: AGF Manufacturing, Inc. Model 7910MAV.

2. Acceptable Manufacturers: AGF Manufacturing, Inc.

2.9 AUTOMATIC AIR VENTS

A. Automatic air vent shall include 1 in. NPT isolation valve with forged brass body and stainless steel 20 mesh strainer, adjustable purge valve with hose connection, threaded cap and lanyard and automatic air release valve with conical body, recessed venting valve, single float on rigid shaft and bubble breaker.

B. Provide with end cap and close nipple (AGF Model 7930ECA**)**

1. Design Equipment: AGF Manufacturing, Inc. Model 7900AAV.

2. Acceptable Manufacturers: AGF Manufacturing, Inc.

2.10 SYSTEM COMPONENT IDENTIFICATION

A. At control, test and drain valves, provide permanently marked identification signs constructed of 18 gauge steel with baked enameled finish. The signs shall be permanently mounted on the piping or wall at the valve, or on the valve, but shall not be hung on the valve with wires or chains which permits easy removal of the sign. The sign shall clearly indicate the valve's purpose and what portion of the structure it serves. Additional signs, shall be provided at each alarm check and dry pipe valve to clearly indicate hydraulic calculation data.

2.11 ADDITIONAL SPRINKLERS AND SPRINKLER GUARDS

A. Include allowance for providing 6 additional sprinklers with related piping, fittings, hangers installed at locations where job conditions or equipment selections may be required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The nature of the work requires coordination with other trades. Shop fabrication shall be done at the Contractor's risk. Relocation of piping and components to avoid obstructions may be necessary. Relocation, if required, shall be done at the Contractor's expense. The installation shall be performed in a workmanlike manner as determined by the Owner's Representative and in accordance with the Contract Documents, manufacturer's printed installation instructions, and submitted and Owner's Representative reviewed drawings.

B. Piping shall not pass directly over electric panelboards, switchboards, motor control centers, and similar electric and telephone equipment. However, protection for these spaces shall be provided.

C. Piping shall be installed concealed above finish ceiling area with sprinklers located in the center of ceiling tiles where ceiling tiles are used.

D. Provide a readily removable flushing connection consisting of a cap at each end of cross mains.

E. Each sprinkler system shall be provided with an automatic vent valve or a manual vent valve located near the high point of the system in accordance with NFPA requirements.

F. Pipe ball drip valves at a floor drain or to the exterior. Pipe 2 in. main drains and water motor gong drains to discharge to the exterior at approximately 2 ft. above finished grade.

G. Securely install the spare sprinkler cabinets to the building wall at the main riser.

H. Inspector's test valves and dry system auxiliary drains shall be installed 7 ft. or less above the finished floor.

I. Fire department connections shall be installed 3 ft. above finished grade and water motor gongs approximately 10 ft. above finished grade.

J. Upright sprinklers directly on branch lines shall be installed with their frame parallel to the piping.

K. Provide sprinkler protection under ductwork, groups of ductwork and other obstructions to water spray and distribution. Use intermediate level sprinklers if subject to waterspray from above.

L. Exposed pipe shall be left clean for painting.

M. Coordinate and activate the systems or portions of the system to operational status as soon as possible.

3.2 PIPING, VALVES AND HANGERS

A. Refer to other applicable sections.

B. All piping shall be installed to permit drainage of the system through a main drain valve. Where a change in piping direction prevents drainage of the system, auxiliary drains shall be provided. The auxiliary drain assembly shall consist of a lockable ball valve, nipple and cap or plug and shall be located 7 ft. or less above the finished floor. Pipe drain to an accessible location.

3.3 TESTS

A. General:

1. Pipe installation shall be inspected by Owner's Representative prior to being covered by building construction or backfill.

2. Give the Owner's Representative advance notice of final tests. Perform tests in a safe manner. Provide written certification that tests have been successfully completed. Use NFPA Above and Below Ground Material and Test Certificate Forms.

3. Correct system leaks prior to final test. Do not utilize water additives, caulking, etc. to correct leaks. Provide appliances, equipment, instruments, devices and personnel.

4. Flushing: Follow Contract Documents and utilize open end pipe sections if possible.

B. Pressure Tests:

1. Hydrostatic Tests: Minimum 200 psi and in accordance with NFPA 13 for two (2) hours.

a. Air test not accepted as final test.

2. Air Test: Minimum 40 psi for 24 hours with loss not to exceed 1.5 psi within 24 hour duration.

3. Do not subject existing systems to excess pressures.

C. Alarm Tests:

1. Demonstrate activation of alarms and operational trip test and water delivery time for dry systems by use of Inspector's test valve.

3.4 SYSTEM TURNOVER

A. Prior to final acceptance, instruct the Owner's Representative in the proper operation, maintenance, testing, inspection and emergency procedures for all systems furnished, for a period of time as needed. Provide one (1) new original pamphlet of NFPA 25. Indicate in writing to the Owner's Representative the provisions for proper maintenance, testing, and inspection of the systems as required by local fire codes.

END OF SECTION

SECTION 220500 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, tools, materials, accessories, parts, transportation, taxes, and related items, essential for installation of the work and necessary to make work, complete, and operational. Provide new equipment and material unless otherwise called for. References to codes, specifications and standards called for in the specification sections and on the drawings mean, the latest edition, amendment and revision of such referenced standard in effect on the date of these contract documents. All materials and equipment shall be installed in accordance with the manufacturer's recommendations.

1.2 LICENSING

A. The Contractor shall hold a license to perform the work as issued by the authority having jurisdiction.

B. Plumbing contract work shall be performed by, or under, the direct supervision of a licensed master plumber.

C. Electrical contract work shall be performed by, or under, the direct supervision of a licensed electrician.

1.3 PERMITS

A. Apply for and obtain all required permits and inspections, pay all fees and charges including all service charges. Provide certificate of approval from the Authorities Having Jurisdiction prior to request for final payment.

B. Provide electrical inspection certificate of approval from Middle Department Inspection Agency, Commonwealth Inspection Agency, or an Engineer approved Inspection Agency prior to request for final payment.

1.4 CODE COMPLIANCE

A. Provide work in compliance with the following:

1. 2020 Building Code of New York State.
2. 2020 Fire Code of New York State.
3. 2020 Plumbing Code of New York State.
4. 2020 Mechanical Code of New York State.
5. 2020 Fuel Gas Code of New York State.
6. 2020 Property Maintenance Code of New York State.
7. 2020 Energy Conservation Code of New York State

8. Accessible and Usable Buildings and Facilities, ICC A117.1 (2009).
9. New York State Department of Labor Rules and Regulations.
10. New York State Department of Health.
11. 2017 National Electrical Code (NEC).
12. Occupational Safety and Health Administration (OSHA).
13. Local Codes and Ordinances.
14. Life Safety Code, NFPA 101.

1.5 GLOSSARY

ACI	American Concrete Institute
AGA	American Gas Association
AGCA	Associated General Contractors of America, Inc.
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AFBMA	Anti-Friction Bearing Manufacturer's Association
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing Materials
AWSC	American Welding Society Code
AWWA	American Water Works Association
FM	Factory Mutual Insurance Company
IBR	Institute of Boiler & Radiation Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association

NYS/DEC	New York State Department of Environmental Conservation
SBI	Steel Boiler Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UFPO	Underground Facilities Protective Organization
UL	Underwriter's Laboratories, Inc.
OSHA	Occupational Safety and Health Administration
XL - GAP	XL Global Asset Protection Services

1.6 DEFINITIONS

Acceptance	Owner acceptance of the project from Contractor upon certification by Owner's Representative.
As Specified	Materials, equipment including the execution specified/shown in the contract documents.
Basis of Design	Equipment, materials, installation, etc. on which the design is based. (Refer to the article, Equipment Arrangements, and the article, Substitutions.)
Code Requirements	Minimum requirements.
Concealed	Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.
Coordination Drawings	Show the relationship and integration of different construction elements and trades that require careful coordination during fabrication or installation, to fit in the space provided or to function as intended.
Delegated-Design Services	Performance and Design criteria for Contractor provided professional services. Where professional design services or certifications by a design professional are specifically required of a Contractor, by the Contract Documents. Provide products and systems with the specific design criteria indicated. If criteria indicated is insufficient to perform services or certification required, submit a written request for additional information to the Engineer. Submit wet signed and sealed certification by the licensed design professional for each product and system specifically assigned to the Contractor to be designed or certified by a design professional. Examples: structural maintenance ladders, stairs and platforms, pipe anchors, seismic compliant system, wind, structural supports for material equipment, sprinkler hydraulic calculations.
Equal, Equivalent, Equal To, Equivalent To, As Directed and As Required	Shall all be interpreted and should be taken to mean "to the satisfaction of the Engineer".
Exposed	Work not identified as concealed.
Extract	Carefully dismantle and store where directed by Owner's Representative

	and/or reinstall as indicated on drawings or as described in specifications.
Furnish	Purchase and deliver to job site, location as directed by the Owner's Representative.
Inspection	Visual observations by Owner's site Representative.
Install	Store at job site if required, proper placement within building construction including miscellaneous items needed to affect placement as required and protect during construction. Take responsibility to mount, connect, start-up and make fully functional.
Labeled	Refers to classification by a standards agency.
Manufacturers	Refer to the article, Equipment Arrangements, and the article, Substitutions.
Prime Professional	Architect or Engineer having a contract directly with the Owner for professional services.
Product Data	Illustrations, standard schedules, performance charts, instructions, brochures, wiring diagrams, finishes, or other information furnished by the Contractor to illustrate materials or equipment for some portion of the work.
Provide (Furnish and Install)	Contractor shall furnish all labor, materials, equipment and supplies necessary to install and place in operating condition, unless otherwise specifically stated.
Relocate	Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use.
Remove	Dismantle and take away from premises without added cost to Owner, and dispose of in a legal manner.
Review and Reviewed	Should be taken to mean to be followed by "for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents".
Roughing	Pipe, duct, conduit, equipment layout and installation.
Samples	Physical full scale examples which illustrate materials, finishes, coatings, equipment or workmanship, and establishes standards by which work will be judged.
Satisfactory	As specified in contract documents.
Shop Drawings	Fabrication drawings, diagrams, schedules and other instruments, specifically prepared for the work by the Contractor or a Sub-contractor, manufacturer, supplier or distributor to illustrate some portion of the work.
Site Representative	Owner's Inspector or "Clerk of Works" at the work site.
Submittals Defined (Technical)	Any item required to be delivered to the Engineer for review as requirement of the Contract Documents. The purpose of technical submittals is to demonstrate for those portions of the work for which a submittal is required, the manner in which the Contractor proposes to conform to the information given and design concepts expressed and required by the Contract Documents.

1.7 SHOP DRAWINGS/PRODUCT DATA/SAMPLES

A. Provide submittals on all items of equipment and materials to be furnished and installed. Submittals shall be accompanied by a transmittal letter, stating name of project and contractor, name of vendor supplying equipment, number of drawings, titles, specification sections (name and number) and other pertinent data called for in individual sections. Submittals shall have individual cover sheets that shall be dated and contain: Name of project; name of prime professional; name of prime contractor; description or names of equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Individual piecemeal or incomplete submittals will not be accepted. Similar items, (all types specified) shall be submitted at under one cover sheet per specification section (e.g. valves, plumbing fixtures, etc.). Number each submittal by trade. Indicate deviations from contract requirements on Letter of Transmittal. Submittals will be given a general review only. Corrections or comments made on the Submittals during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. If submitting hard copies, submit four (4) copies for review.

B. If submittals are to be submitted electronically, all requirements in Item A apply. Submittals shall be emailed in PDF format to specific email address provided by the Construction Manager, General Contractor, Architect or Project Manager. Name of project shall be in subject line of email. Send emails to mealbasubmittalclerk@meengineering.com.

C. Refer to Division 01 for additional requirements.

1.8 PROTECTION OF PERSONS AND PROPERTY

A. Contractor shall assume responsibility for construction safety at all times and provide, as part of contract, all trench or building shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, and other safety feature required to provide safe conditions for all workmen and site visitors.

1.9 EQUIPMENT ARRANGEMENTS

A. The contract documents are prepared using one manufacturer as the Basis of Design, even though other manufacturers' names are listed. If Contractor elects to use one of the listed manufacturers other than Basis of Design, submit detailed drawings, indicating proposed installation of equipment. Show maintenance clearances, service removal space required, and other pertinent revisions to the design arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger motors, feeders, breakers, and equipment, additional control devices, valves, fittings and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of roughing and connections by other trades. Remove and replace doorframes, access doors, walls, ceilings, or floors required to install other than Basis of

Design. If revised arrangement submittal is rejected, revise and resubmit specified Basis of Design item which conforms to Contract Documents.

1.10 SUBSTITUTIONS

A. If Contractor desires to bid on any other kind, type, brand, or manufacture of material or equipment than those named in specifications, secure prior approval. To request such approval, Contractor shall submit complete information comparing (item-for-item) material or equipment offered with design material or equipment. Include sufficient information to permit quick and thorough comparison, and include performance curves on same basis, capacities, power requirements, controls, materials, metal gauges, finishes, dimensions, weights, etc., of major parts. If accepted, an addendum will be issued to this effect ahead of bid date. Unless such addendum is issued, substitution offered may not be used.

1.11 UTILITY COMPANY SERVICES

A. Division 26 shall make arrangements with National Grid for electric service to the Owner's distribution equipment. Provide underground or overhead electric service as called for and transformers, meter sockets or meter compartments as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the electric service shall comply with the published Utility Company standards

B. Division 22 shall make arrangements with National Grid for gas service to the Owner's distribution system. Provide service to the building as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the gas service shall comply with the published Utility Company standards

1.12 ROUGHING

A. The Contract Drawings have been prepared in order to convey design intent and are diagrammatic only. Drawings shall not be interpreted to be fully coordinated for construction.

B. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Make necessary changes in contract work, equipment locations, etc., as part of a contract to accommodate work to avoid obstacles and interferences encountered. Before installing, verify exact location and elevations at work site. DO NOT SCALE plans. If field conditions, details, changes in equipment or shop drawing information require an important rearrangement, report same to Owner's Representative for review. Obtain written approval for all major changes before installing.

C. Install work so that items both existing and new are operable and serviceable. Eliminate interference with removal of coils, motors, filters, belt guards and/or operation of doors. Provide easy, safe, and code mandated clearances at controllers, motor starters, valve access, and other equipment requiring maintenance and operation. Provide new materials, including new piping and insulation for relocated work.

D. Coordinate work with other trades and determine exact route or location of each duct, pipe, conduit, etc., before fabrication and installation. Coordinate with Architectural Drawings. Obtain from Owner's Representative exact location of all equipment in finished areas, such as thermostat, fixture, and switch mounting heights, and equipment mounting heights. Coordinate all work with the architectural reflected ceiling plans and/or existing Architecture. Mechanical and electrical drawings show design arrangement only for diffusers, grilles, registers, air terminals, lighting fixtures, sprinklers, speakers, and other items. Do not rough-in contract work without reflected ceiling location plans.

E. Before roughing for equipment furnished by Owner or in other Divisions, obtain from Owner and other Divisions, approved roughing drawings giving exact location for each piece of equipment. Do not "rough in" services without final layout drawings approved for construction. Cooperate with other trades to insure proper location and size of connections to insure proper functioning of all systems and equipment. For equipment and connections provided in this contract, prepare roughing drawing as follows:

1. Existing Equipment: Measure the existing equipment and prepare for installation in new location.

2. New Equipment: Obtain equipment roughing drawings and dimensions, then prepare roughing-in-drawings. If such information is not available in time, obtain an acknowledgement in writing, then make space arrangements as required with Owner's Representative.

1.13 COORDINATION DRAWINGS

A. Before construction work commences, Divisions for all trades shall submit coordination drawings in the form of CAD drawing files, drawn at not less than 1/4 in. scale. Such drawings will be required throughout all areas, for all Contracts. These drawings shall show resolutions of trade conflicts in congested areas. Mechanical Equipment Rooms shall be drawn early in coordination drawing process simultaneous with all other congested areas. Prepare Coordination Drawings as follows:

1. Division 23 shall prepare the base plan CAD coordination drawings showing all ductwork, all pertinent heating piping, and equipment. These drawings may be CAD files of the required Ductwork Shop Drawings. The drawings shall be coordinated with lighting fixtures, sprinklers, air diffusers, other ceiling mounted items, ceiling heights, structural work, maintenance clearances, electric code clearance, reflected ceiling plans, and other contract requirements. Reposition proposed locations of work after coordination drawing review by the Owner's Representative. Provide adjustments to exact size, location, and offsets of ducts, pipes, conduit, etc., to achieve reasonable appearance objectives. Provide these adjustments as part of contract. Minor revisions need not be redrawn.

2. Division 23shall provide CAD files and submit the base plan CAD Coordination Drawings to all Divisions.

3. Divisions 21 and 22 shall draw the location of piping and equipment on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolutions.

4. Divisions 26, 27 and 28 shall draw the location of lighting fixtures, cable trays, and feeders over 1-1/2 in. on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolution.

5. The General Construction Trade shall indicate areas of architectural/structural conflicts or obstacles on the CAD Coordination Drawings, and coordinate to suit the overall construction schedule.

6. The General Construction Trade shall expedite all Coordination Drawing work and coordinate to suit the overall construction schedule. In the case of unresolved interferences, he shall notify the Owner's Representative. The Owner's Representative will then direct the various trades as to how to revise their drawings as required to eliminate installation interferences.

7. If a given trade proceeds prior to resolving conflicts, then if necessary, that trade shall change its work at no extra cost in order to permit others to proceed with a coordinated installation. Coordination approval will be given by areas after special site meetings involving all Divisions.

B. The purpose of the coordination drawing process is to identify and resolve potential conflicts between trades, and between trades and existing or new building construction, before they occur in construction. Coordination drawings are intended for the respective trade's use during construction and shall not replace any Shop Drawings, or record drawings required elsewhere in these contract documents.

1.14 EQUIPMENT AND MATERIAL REQUIREMENTS

A. Provide materials that meet the following minimum requirements:

1. Materials shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less, in accordance with NFPA 255.

2. All equipment and material for which there is a listing service shall bear a UL label.

3. Potable water systems and equipment shall be built according to AWWA Standards.

4. Gas-fired equipment and system shall meet AGA Regulations and shall have AGA label.

5. Fire protection equipment shall be UL listed and FM approved.

B. Exterior and wet locations shall utilize materials, equipment supports, mounting, etc. suitable for the intended locations. Metals shall be stainless steel, galvanized or with baked enamel finish as a minimum. Finishes and coatings shall be continuous and any surface damaged or cut ends shall be field corrected in accordance with the manufacturer's recommendations. Hardware (screws, bolts, nuts, washers, supports, fasteners, etc.) shall be:

1. Stainless steel where the associated system or equipment material is stainless steel or aluminum.

2. Hot dipped galvanized or stainless steel where the associated system or equipment is steel, galvanized steel or other.

1.15 CUTTING AND PATCHING

A. Each trade shall include their required cutting and patching work unless shown as part of the General Construction Contract. Refer to General Conditions of the Contract for Construction, for additional requirements. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch cut or abandoned holes left by removals of equipment or fixtures. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

1.16 PAINTING

A. Paint all insulated and bare piping, pipe hangers and supports exposed to view in mechanical equipment rooms, penthouse, boiler rooms and similar spaces. Paint all bare piping, ductwork and supports exposed to the out-of-doors with rust inhibiting coatings. Paint all equipment that is not factory finish painted (i.e. expansion tanks, etc.).

B. All painting shall consist of one (1) prime coat and two (2) finish coats of non-lead oil base paint, unless otherwise indicated herein. Provide galvanized iron primer for all galvanized surfaces. All surfaces must be thoroughly cleaned before painting. Review system color coding prior to painting with the Owner's Representative or Architect.

C. All items installed after finished painting is completed and any damaged factory finish paint on equipment furnished under this contract must be touched up by the Contractor responsible for same.

D. Include painting for patchwork with color to match adjacent surfaces. Where color cannot be adequately matched, paint entire surface. Provide one (1) coat of primer and two (2) finish coats or as called for in the Specifications.

E. All primers and paint used in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

F. Refer to Division 9 - Finishes, for additional information.

1.17 CONCEALMENT

A. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

1.18 CHASES

A. New Construction:

1. Certain chases, recesses, openings, shafts, and wall pockets will be provided as part of General Construction Trade. Mechanical and Electrical trades shall provide all other openings required for their contract work.

2. Check Architectural and Structural Design and Shop Drawings to verify correct size and location for all openings, recesses and chases in general building construction work.

3. Assume responsibility for correct and final location and size of such openings.

4. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.

5. Provide 18 gauge galvanized sleeves and inserts. Extend all sleeves 2 in. above finished floor. Set sleeves and inserts in place ahead of new construction, securely fastened during concrete pouring. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Firestop all unused sleeves.

6. Provide angle iron frame where openings are required for contract work, unless provided by General Construction trade.

1.19 PENETRATION FIRESTOPPING

A. Fire-Stopping for Openings Through Fire and Smoke Rated Wall and Floor Assemblies:

1. Provide materials and products listed or classified by an approved independent testing laboratory for "Penetration Fire-Stop Systems". The system shall meet the requirements of "Fire Tests of Penetrations Fire-Stops" designated ASTM E814.

2. Provide fire-stop system seals at all locations where piping, tubing, conduit, electrical busways/cables/wires, ductwork and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities which permit the easy removal or addition of electrical conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion, and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating.

5. Plastic pipe/conduit materials shall be installed utilizing intumescent collars.

6. Provide a submittal including products intended for use, manufacturer's installation instructions, and the UL details for all applicable types of wall and floor penetrations.

7. Fire-stopping products shall not be used for sealing of penetrations of non-rated walls or floors.

B. Acceptable Manufacturers:

1. Dow Corning Fire-Stop System Foams and Sealants.

2. Nelson Electric Fire-Stop System Putty, CLK and WRP.

3. S-100 FS500/600, Thomas & Betts.

4. Carborundum Fyre Putty.

5. 3-M Fire Products.

6. Hilti Corporation.

1.20 NON-RATED WALL PENETRATIONS

A. Each trade shall be responsible for sealing wall penetrations related to their installed work, including but not limited to ductwork, piping, conduits, etc. See individual specification sections for requirements.

1.21 SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, and other items to properly support contract work. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above.

B. For precast panels/planks and metal decks, support mechanical/electrical work as determined by manufacturer and the Engineer. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

C. For finished areas without a finished ceiling system such as classrooms, offices, conference rooms, etc., where decking and structure is exposed, and ductwork/piping/conduit is exposed: All mounting brackets, channel support systems and mounting hardware for ductwork, piping, lighting, etc. shall be concealed and approved by the Architect/Engineer prior to the installation. AirCraft cable style hanging for ductwork is required. It is recommended that room mockups be done and receive Architect/Engineer approval prior to proceeding with installation.

D. Equipment, piping, conduit, raceway, etc. supports shall be installed to minimize the generation and transmission of vibration.

E. Materials and equipment shall be solely supported by the building structure and connected framing. Gypboard, ceilings, other finishes, etc. shall not be used for support of materials and equipment.

1.22 ACCESS PANELS

A. Provide access panels for required access to respective trade's work. Location and size shall be the responsibility of each trade. Access panels provided for equipment shall provide an opening not smaller than 22 in. by 22 in. Panels shall be capable of opening a minimum of 90 degrees. Bear cost of construction changes necessary due to improper information or failure to provide proper information in ample time. Access panels over 324 square inches shall have two cam locks. Provide proper frame and door type for various wall or ceiling finishes. Access panels shall be equal to "Milcor" as manufactured by Inland Steel Products Co., Milwaukee, Wisconsin. Provide General Construction trade with a set of architectural plans with size and locations of access panels.

1.23 CONCRETE BASES

A. Provide concrete bases for all floor mounted equipment. Provide 3,000 lb. concrete, chamfer edges, trowel finish, and securely bond to floor by roughening slab and coating with cement grout. Bases 4 in. high (unless otherwise indicated); shape and size to accommodate equipment. Provide anchor bolts in equipment bases for all equipment provided for the project, whether mounted on new concrete bases or existing concrete bases.

1.24 HVAC EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide final connections to all equipment as required by the equipment. Provide final connections, including domestic water piping, wiring, controls, and devices from equipment to outlets left by other trades. Provide equipment waste, drip, overflow and drain connections extended to floor drains.

C. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, as required.

1.25 PLUMBING EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide roughing and final connections to all equipment. Provide loose key stops, sanitary "P" traps, tailpiece, adapters, gas or air cocks, and all necessary piping and fittings from roughing point to equipment. Provide installation of sinks, faucets, traps, tailpiece furnished by others. Provide cold water line with gate valve and backflow prevention device at locations called for. Provide continuation of piping and connection to equipment that is furnished by others. Provide relief valve discharge piping from equipment relief valves.

C. Provide valved water outlet adjacent to equipment requiring same. Provide equipment type floor drains, or drain hubs, adjacent to equipment.

D. Install controls and devices furnished by others.

E. Refer to Contract Documents for roughing schedules, and equipment and lists indicating scope of connections required.

F. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, as required.

1.26 ELECTRICAL EQUIPMENT CONNECTIONS

A. Provide complete power connections to all electrical equipment. Provide control connections to equipment. Heavy duty NEC rated disconnect ahead of each piece of equipment. Ground all equipment in accordance with NEC.

B. Provide for Owner furnished and Contractor furnished equipment all power wiring, electric equipment, control wiring, switches, lights, receptacles, and connections as required.

1.27 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

A. Store Materials on dry base, at least 6 in. aboveground or floor. Store so as not to interfere with other work or obstruct access to buildings or facilities. Provide waterproof/windproof covering. Remove and provide special storage for items subject to moisture damage. Protect against theft or damage from any cause. Replace items stolen or damaged, at no cost to Owner.

B. Refer to Division 01 for additional information.

1.28 FREEZING AND WATER DAMAGE

A. Take all necessary precautions with equipment, systems and building to prevent damage due to freezing and/or water damage. Repair or replace, at no change in contract, any such damage to equipment, systems, and building. Perform first seasons winterizing in presence of Owner's operating staff.

1.29 OWNER INSTRUCTIONS

A. Before final acceptance of the work, furnish necessary skilled labor to operate all systems by seasons. Instruct designated person on proper operation, and care of

systems/equipment. Repeat instructions, if necessary. Obtain written acknowledgement from person instructed prior to final payment. Contractor is fully responsible for system until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing. List under clear plastic, operating, maintenance, and starting precautions procedures to be followed by Owner for operating systems and equipment.

1.30 OPERATION AND MAINTENANCE MANUALS

A. Submit by email (preferred) or digital media, thru the normal project submittal process. Include a copy of each final approved Shop Drawing, wiring diagrams, piping diagrams, spare parts lists, final testing and balancing report, as-built drawings and manufacturer's instructions. Include typewritten instructions, describing equipment, starting/operating procedures, emergency operating instructions, summer-winter changeover, freeze protection, precautions and recommended maintenance procedures. Include name, address, and telephone number of installing contractor and of supplier manufacturer Representative and service agency for all major equipment items. Provide a table of contents page and dividers based upon specification section numbers. Submit in a compiled and bookmarked PDF format as outlined below.

B. Provide content for Operation and Maintenance Manuals as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer and Commissioning Agent will comment on whether content of operation and maintenance submittals is acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

C. Submit Operation and Maintenance Manuals in the following format:

1. Submit by uploading to web-based project software site, or by email to Architect, as a formal project submittal in conformance with the project specific submittal procedures. Enable reviewer comments on draft submittals.

2. 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.

3. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in the 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.

D. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing Owner training. Engineer and Commissioning Agent will comment on whether general scope and content of manual are acceptable.

E. Final Manual Submittal: Submit O&M manual in final form prior to requesting inspection for Substantial Completion and at least 2 weeks before commencing Owner training. Engineer and Commissioning Agent will return copy with review comments.

1. Correct or revise O&M manual to comply with Engineer's and Commissioning Agent's comments. Submit copies of each corrected manual within 2 weeks of receipt of Engineer's and Commissioning Agent's comments.

F. Refer to Division 01 for additional requirements.

1.31 RECORD DRAWINGS

A. The Contractor shall obtain at his expense one (1) set of construction Contract Drawings, (including non-reproduction black and white prints or electronic files) for the purpose of recording as-built conditions.

B. The Contractor shall perform all survey work required for the location and construction of the work and to record information necessary for completion of the record drawings. Record drawings shall show the actual location of the constructed facilities in the same manner as was shown on the bid drawings. All elevations and dimensions shown on the drawings shall be verified or corrected so as to provide a complete and accurate record of the facilities as constructed.

C. It shall be the responsibility of the Contractor to mark EACH sheet of the contract documents in red and to record thereon in a legible manner, any and all approved field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other changes shall also be maintained. At completion of the work, the complete set of red marked contract documents, plus all approved field sketches and diagrams shall be submitted to the engineer and used in preparation of the record drawings.

D. A complete set of red marked contract drawings shall be submitted, at one time, as the "Record" set. If there are no changes to a specific drawing, the contractor shall indicate "NO CHANGES" on that drawing. ALL drawings shall be included in the "Record" set.

E. The complete set of red marked Contract Documents or electronic files shall be certified by the Contractor as reflecting record conditions and submitted to the engineer for review.

F. The Contractor shall have the marked up set scanned, if they are not already electronic files, and then submit them to the Engineer as the "Record Set".

G. Refer to Division 01 for additional requirements.

1.32 FINAL INSPECTION

A. Upon completion of all Engineering Site Observation list items, the Contractor shall provide a copy of the Engineering Site Observation Report back to the Engineer with each items noted as completed or the current status of the item. Upon receipt, the Engineer will schedule a final review.

1.33 COMMISSIONING

A. Refer to General Commissioning Requirements in Division 01 for additional requirements.

1.34 TEMPORARY HEATING AND COOLING

A. Refer to the General Conditions of the Contract for Construction and Supplemental General Conditions.

1.35 MAINTENANCE OF HVAC SYSTEMS DURING TEMPORARY USE PERIODS

A. Provide each air handling system with a set of prefilters in addition to the permanent filters. Furnish four sets of prefilters for each system for use when system is operated for temporary heating or cooling. During such use, change prefilters as often as directed by Owner's Representative. Provide MERV-8 filters in all open ended ducts, return grilles and registers to keep dust out of ductwork. Change as often as necessary. Remove all such temporary filters upon completion. Use supply fans only. Do not operate return fans.

B. Blank-off outside air intake opening during temporary heating period. Install first set of permanent filters and prefilters.

C. Adjust dampers on supply system.

D. Set all heating coil control valves for manual operation.

E. Do not install any grilles or diffusers at room terminal ends of ducts until permission is given.

F. Assume responsibility for systems and equipment at all times, even though used for temporary heat or ventilating. Repair or replace all dented, scratched or damaged parts of systems prior to final acceptance.

G. Remove concrete, rust, paint spots, other blemishes, then clean.

H. Just prior to final acceptance, remove used final filter and install new set. Deliver all unused sets of prefilters to the Owner and obtain written receipt. Properly lubricate system bearings before and during temporary use. Maintain thermostats, freeze stats, overload devices, and all other safety controls in operating condition.

1.36 TEMPORARY FACILITIES

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.37 TEMPORARY LIGHT AND POWER

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.38 CLEANING

A. It is the Contractor's responsibility to keep clean all equipment and fixtures provided under this contract for the duration of the project. Each trade shall keep the premises free from an accumulation of waste material or rubbish caused by his operations. The facilities require an environment of extreme cleanliness, and it is the Contractor's responsibility to adhere to the strict regulations regarding procedures on the existing premises. After all tests are made and installations completed satisfactorily:

1. Thoroughly clean entire installation, both exposed surfaces and interiors.

2. Remove all debris caused by work.

3. Remove tools, surplus, materials, when work is finally accepted.

1.39 SYSTEM START-UP AND TESTING

A. Prior to commencement of work, the Division(s) effecting such system shall survey all building mechanical, plumbing, fire protection and electrical systems and components and make written notice to the Owner's Representative regarding any damage, missing items and/or incomplete systems. Prior to the conclusion of this project, the Contractor shall verify with the Owner's Representative that all building systems have been returned to their original conditions.

1.40 TRANSFER OF ELECTRONIC FILES

A. M/E Engineering, P.C. will provide electronic files for the Contractor's use in the preparation of sheetmetal shop drawings, coordination drawings, or record drawings related to the project, subject to a and the following terms and conditions:

1. The Contractor shall submit a formal request for electronic drawing files on the M/E Engineering, P.C. website, by utilizing the following website link: http://www.meengineering.com/contact-pages/contractor-request.

2. M/E Engineering, P.C. makes no representation as to the compatibility of these files with the Contractor's hardware or the Contractor's software beyond the specific release of the referenced specifications.

3. M/E Engineering, P.C. can only provide CAD files of M/E/P/FP drawing levels for which we are the Engineer of Record. CAD files of Architectural backgrounds, reflected ceiling plans, structural plans, etc. must be obtained separately from the Architect of Record.

4. Data contained on these electronic files is part of M/E Engineering, P.C.'s instruments of service shall not be used by the Contractor or anyone else receiving data through or from the Contractor for any purpose other than as convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by the Contractor or by others will be at the Contractor's sole risk and without liability or legal exposure to M/E Engineering, P.C. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against M/E

Engineering, P.C., its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with the Contractor's use of the electronic files.

5. Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless, M/E Engineering, P.C. from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from the Contractor's use of these electronic files.

6. These electronic files are not contract documents. Significant difference may arise between these electronic files and corresponding hard copy contract documents due to addenda, change orders or other revisions. M/E Engineering, P.C. makes no representation regarding the accuracy or completeness of the electronic files the Contractor receives. In the event that a conflict arises between the signed contract documents prepared by M/E Engineering, P.C. and electronic files, the signed contract documents shall govern. The Contractor is responsible for determining if any conflicts exist. By the Contractor's use of these electronic files the Contractor is not relieved of the Contractor's duty to comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, field verify conditions and coordinate the Contractor's work with that of other contractors for the project.

1.41 ENERGY INCENTIVES

A. The Contractor, his Subcontractors and Suppliers shall provide to the Owner all paperwork necessary to support the Owners pursuit of incentives related to energy conservation as offered by the utility company or state sponsored incentive programs. This shall include at a minimum, receipts, and quantities and data sheets for energy efficient equipment such as: lighting, motors, variable frequency drives, etc.

END OF SECTION

SECTION 220523 - VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Document.

1.2 SUBMITTALS

A. Submit manufacturer's data in accordance with Basic Mechanical and Electrical Requirements. Obtain approval prior to ordering material.

B. Provide submittals for all items specified under Part 2 of this section.

PART 2 - PRODUCTS

2.1 VALVES - GENERAL

A. Valves shall have following requirements:

1. Working pressure stamped or cast on bodies.

2. Stem packing serviceable without removing valve from line.

3. All items here-in used to convey water for potable use shall be lead free in accordance with NSF Standard, Standard 61, Section 9 - Standard for Drinking Water and Lavatory Faucets and NSF Standard 372 - Maximum Lead Requirements. Compliance shall be via third party testing and certification.

B. Acceptable Manufacturers:

1. Balance Valves: Armstrong, Bell & Gossett, Red White, Taco, Tour and Anderson.

2. Ball Valves: Apollo, Hammond, Milwaukee, Nibco, Red White, Watts.

3. Butterfly Valves: Bray, Jamesbury, Keystone, Milwaukee, Red White, Watts.

4. Gate and Check Valves: Hammond, Milwaukee, Nibco, Red White, Stockham, Watts.

5. To establish a standard of quality and identify features, certain manufacturer's numbers are given in the following paragraphs.

2.2 DOMESTIC WATER VALVES

A. Gate Valves:

1. 4 in. and Larger, Hot Water Service: IBBM, solid wedge disc, OS&Y, flanged ends, 125 SWP; Milwaukee F-2885.

2. 4 in. and Larger, Cold Water Service: Epoxy coated, resilient wedge, OS&Y, flanged ends, 175 wwp, UL/FM; Watts 408 RW.

3. 3 in. and Smaller: Bronze, solid wedge disc, rising stem, 125 SWP; Milwaukee 1152 (threaded ends, union bonnet) or Milwaukee 149 (sweat ends, threaded bonnet.)

B. Check Valves:

1. 3 in. and Larger: IBBM, renewable seat and disc, bolted flange cap, flanged ends, 125 SWP; Milwaukee F-2974.

2. 2 in. and Smaller: Lead-free swing check with silicone bronze body, bonnet and trim, PTFE disc seat and stainless steel seat disc washer, 200 psi working pressure, Nibco T-413-Y-LF (threaded) or Nibco's S-413-Y-LF (solder).

3. Silent Type: Lead-free spring check with silicone bronze body, stainless steel trim and PTFE disc: 250 psi working pressure; Nibco T-480-4-LF (threaded) or Nibco S-480-Y-LF (solder).

C. Ball Valves:

1. 2-1/2 in. and Larger: Lead-free, forged copper silicon 2-piece body, chrome plated brass ball, full port, teflon seats and stem packing, separate packing and handle nut, blowout proof stem extended for insulation, vinyl insulator for handle, 600 WOG, 125 WSP; Watts LF-FBV-3C Series (threaded ends) or Watts LF-FBVS-3C series (sweat ends).

2. 2 in. and Smaller: Lead-free, brass 2-piece body, 316 stainless steel ball and stem, full port, teflon seats and stem packing, separate packing and handle nut, blow out proof stem extended for insulation, vinyl insulator for handle, 600 WOG, 150 SWP: Watts #LFB-6080 (threaded ends) or Watts #LFB-6081 (sweat ends).

3. 2 in. and Smaller: True union style, CPVC body and ball, 150 psi, EPDM O-ring seals, constructed for end entrance with socket, flanged or threaded ends, full port design, conforming to and listed by NSF 14 for potable water.

D. Balance Valves:

1. 2 in. and Smaller: Lead-free, brass body, chrome plated brass ball, glass and carbon filled PTFE seat rings, Viton packing, threaded or solder ends, differential readout ports, calibrated nameplate and memory stop indicator rated for 125 psi; and pre-formed insulation to permit access for balancing and readout; Watt Series LFCSM-61-S.

a. Balance valve sizes shall be based upon gpm range rather than pipe size.

Balance Valve Size	GPM Range
1/2 in.	Up to 2.5

Balance Valve Size	GPM Range
3/4 in.	2.5 - 4.5
1 in.	4.5 - 10
1-1/4 in.	10 - 15
1-1/2 in.	15 - 30
2 in.	30 - 60

E. Valves for Gauges and Instruments:

1. 1/2 in. Size: Brass bar stock for 1000 psi and 300°F; Trerice No. 735 needle valve.

F. Hose Thread Drain Valves:

1. Ball valve, bronze body, hardened chrome ball with hose thread end, cap and chain; Watts #B6001CC (sweat connection), Watts #B6000CC (threaded connection).

2.3 GAS VALVES

A. Plug Valves:

1. 2 in. and Smaller: Semi-steel body and plug, short pattern, 100% pipe area round port, full bore lubricated plug, wrench operated with handle, sealing compound suitable with natural gas, threaded ends, 200 WOG, UL Listed for natural gas; Homestead Figure 651.

2. 2-1/2 in. thru 4 in.: Semi-steel body and plug, short pattern, 100% pipe area round port, full bore lubricated plug, wrench operated with handle, sealing compound suitable with natural gas, flanged ends, 200 WOG, UL listed for natural gas; Homestead Figure 652.

3. 6 in. thru 12 in.: Semi-steel body and plug, short pattern, 100% pipe area round port, full bore lubricated plug, gear operated with handle, sealing compound suitable with natural gas, flanged ends, 200 WOG, UL listed for natural gas; Homestead Figure 652-G.

B. Ball Valves:

1. 2 in. and Smaller: Ball type, two-piece, full port, brass body with chrome plated brass ball, teflon seats, threaded ends, 600 psi WOG, UL listed for natural gas, Watts FBV-3C-UL.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide all shutoff, check, balancing and other type valves as indicated, as required by Code and as required for proper system maintenance, isolation and safety. Provide at major building and systems sections. Provide shutoff valves on all branch lines serving

two fixtures or more, at all equipment, fixtures, before and after automatic control valves, and at future connections.

B. Locate valves for easy access and provide separate support where necessary. Install valves with stems at or above the horizontal position. Install swing check valves in horizontal position with hinge pin level.

C. Provide drain valves with hose thread connections on all equipment. Provide hose thread drain valves at all low points to enable complete drainage of all piping systems including, water mains, branches, at base of vertical risers and at strainers.

D. Provide shutoff valve and wye-strainer before all automatic control valves and pressure reducing valves.

E. Inspect valves for proper operation before installation. Install underground valve boxes vertically over each valve. Adjust top of box to proper grade. Immediately backfill with crushed stone and carefully tamp into place. Unless otherwise noted, leave in the open position.

3.2 DOMESTIC WATER SYSTEM

A. The main water service shutoff valve inside the building and valves for a 3 in. and larger water meter assembly shall be OS&Y gate valves in accordance with the local water authority requirements.

B. Install balance valves in each hot water circulation branch and where noted.

3.3 NATURAL GAS SYSTEM

A. Ball valves shall be UL listed for use in natural gas systems, or certified by another acceptable third-party testing agency.

END OF SECTION

SECTION 220553 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services as required for the complete installation designed in Contract Documents.

1.2 QUALIFICATIONS

A. All identification devices shall comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles.

1.3 SUBMITTALS

A. Submit manufacturer's technical product data and installation instructions for each identification material and device. Submit valve schedule for each piping system typewritten on an 8-1/2 in. x 11 in. paper (minimum), indicating valve number, location and valve function. Submit schedule of pipe, equipment and name identification for review before stenciling or labeling.

1.4 MAKES

A. Allen Systems, Inc., Brady (W.H.) Co.; Signmark Div., Industrial Safety Supply Co., Inc., Seton Name Plate Corp.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide manufacturer's standard products of categories and types required for each application. In cases where there is more than one type specified for an application, selection is installer's option, but provide single selection for each product category.

B. All adhesives used for labels in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits as called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

2.2 PIPING IDENTIFICATION

A. Identification Types:

1. Pressure Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers complying with ANSI A13.1. Provide a 360° wrap of flow arrow tape at each end of pipe label.

O.D. PIPE OR COVERING	SIZE STENCIL LETTER
3/4 in., 1 in., 1-1/4 in.	1/2 in.
1-1/2 in., 2 in.	3/4 in.
2-1/2 in. and over	1-1/4 in.

B. Lettering:

1. Piping labeling shall conform to the following list:

PIPE FUNCTION	IDENTIFICATION
Cold Water	DOMESTIC COLD WATER
Hot Water	DOMESTIC HOT WATER
Hot Water Recirculating	DOMESTIC HOT WATER RECIRCULATING
140 Degree Hot Water	DOMESTIC HOT WATER - 140°F
140 Degree Hot Water Recirculating	DOMESTIC HOT WATER RECIRCULATING - 140°F
Sanitary Waste	SANITARY WASTE
Indirect Waste	INDIRECT WASTE
Storm	STORM
Vent	VENT
Pump Discharge	PUMP DISCHARGE
Natural Gas	NATURAL GAS
Compressed Air	COMPRESSED AIR
Acid Vent	ACID VENT
Acid Waste	ACID WASTE
Soft Water	SOFT WATER
Reverse Osmosis	R/O WATER
Deionized Water	DEIONIZED WATER
Non-Potable Water	NON-POTABLE WATER
Vacuum	VACUUM
Oxygen	OXYGEN
Nitrogen	NITROGEN
Medical Vacuum	MEDICAL VACUUM
Medical Compressed Air	MEDICAL AIR
Nitrous Oxide	NITROUS OXIDE
Carbon Dioxide	CARBON DIOXIDE
Decontamination Piping	DECON WASTE
Waste Anesthesia Gas Disposal	WAGD
Propane	PROPANE GAS
Exhaust Air	EXHAUST AIR

2.3 VALVE IDENTIFICATION

A. Valve Tags:

1. Standard brass valve tags, 2 in. diameter with 1/2 in. high black-filled numerals. Attach to valve with brass jack chain and "S" hook. Identify between heating and plumbing services with 1/4 in. letters above the valve number.

2. Acceptable Manufacturers: Seton Style No. M4507, or approved equal.

B. Valve Chart:

1. Provide valve chart for all valves provided as a part of this project. Frame and place under clear glass. Mount in Mechanical Room.

2.4 EQUIPMENT IDENTIFICATION

A. General:

1. Provide engraved vinyl nameplates for each major piece of mechanical equipment provided, 2-1/2 in. x 3/4 in. size.

2. Acceptable Manufacturers: Seton Style No. M4562, or approved equal.

2.5 ABOVE CEILING EQUIPMENT LOCATOR

A. 3/4 in. diameter adhesive stickers placed on ceiling grid and color-coded.

B. The color for all plumbing valves shall be BLUE.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide valve tags for all valves provided on project.

B. Provide equipment tags for all equipment provided on project.

C. Provide piping identification with directional flow arrows for all piping on project, maximum intervals of 20'-0". For piping installed through rooms, provide at least one (1) pipe label in each room, for each pipe function.

END OF SECTION

SECTION 220593 - ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for complete adjusting and balancing Work as required in Contract Documents.

1.2 SUBMITTALS

A. Provide information in report form listing items required by specifications. Report shall be typed and three copies submitted for review. Results shall be guaranteed. Contractor shall be subject to recall to site to verify report information before acceptance of the report by the Owner's Representative.

B. Report format shall consist of the following:

1. Title sheet with job name, contractor, engineer, date, balance contractor's name, address, telephone number and contact person's name and the balancing technician's name.

1.3 QUALIFICATIONS

A. Follow procedures and methods published by one or more of the following:

1. Individual manufacturer requirements and recommendations.

B. Maintain qualified person at project for system operation, trouble shooting and perform mechanical adjustments in conjunction with balancing procedure.

C. Balancing contractor shall be current member of AABC or NEBB.

1.4 GENERAL REQUIREMENTS

A. Before concealment of systems visit the job site to verify and advise on type and location of balancing devices and test points. Make changes as required to balancing facilities.

B. Place systems in satisfactory operating condition.

1. Adjusting and balancing shall be accomplished as soon as the systems are complete and before Owner takes possession.

2. Prior to balancing adjust balancing devices for full flow; fill, vent and clean hydronic systems, replace temporary strainers.

3. Initial adjustment and balancing to quantities as called for or as directed by the engineer, to satisfy job conditions.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide tools, ladders, recording meters, gauges, thermometers, velometers, anemometers, inclined gauge manometers, magnehelic gauges, amprobes, voltmeters, psychrometers and tachometers required. Instruments used shall be accurately calibrated as per AABC or NEBB requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine Bid Documents and notify Owner's Representative of any questions regarding balancing, within thirty (30) days after receipt of bid and prior to starting work.

3.2 WATER SIDE

A. Test, adjust and record the following:

1. Hot Water Recirculating Pump:

    a. Check rotation
    b. GPM
    c. Running suction pressure
    d. Running discharge pressure
    e. Running load amps
    f. RPM - motor
    g. Complete nameplate motor and pump

2. Recirculation Balancing Valves:

    a. Balance every valve to 1.0 GPM, unless otherwise noted.

END OF SECTION

SECTION 220700 - INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUBMITTAL

A. Shall include product description, manufacturer's installation instructions, types and recommended thicknesses for each application, and location of materials.

PART 2 - PRODUCTS

2.1 GENERAL

A. Insulation, jackets, adhesive, and coatings shall comply with the following:

1. Treatment of jackets or facing for flame and smoke safety must be permanent. Water-soluble treatments not permitted.

2. Insulation, including finishes and adhesives on the exterior surfaces of pipes and equipment, shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

3. Asbestos or asbestos bearing materials are prohibited.

4. Comply with 2020 International Energy Conservation Code as amended by Part 1 of the 2020 Supplement to the New York State Energy Conservation Code.

5. All adhesives and sealants used for insulation in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits as called for in the current version of U.S. Green Building Council LEED Credits EQ E4.1 and EQ E4.2.

6. Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least two (2) years prior to bid opening. Provide insulation systems in accordance with the approved MICA or NAIMA Insulation Standards.

7. Insulation shall be clearly marked with manufacturer's name, identification of installed thermal resistance (R) value, out-of-package R value, flame spread and smoke developed indexes in accordance with Energy Code requirements.

2.2 ACCEPTABLE MANUFACTURERS

A. Fiberglass: Knauf, Johns Manville, Owen-Corning, Certainteed.

B. Polyisocyanurate: Dow Trymer 2000XP, HyTherm.

C. Calcium Silicate: Industrial Insulation Group (ILG).

D. Flexible Elastomeric: Armacell, K-Flex.

E. Adhesives: Childers Products, Foster.

F. Heat Tracing: Raychem, Thermon.

2.3 PIPE INSULATION (RIGID FIBERGLASS TYPE)

A. Product meeting ASTM C 547, ASTM C 585, and ASTM C 795; rigid, molded, noncombustible.

B. 'K' Value: ASTM C 335, 0.23 at 75°F mean temperature. Maximum Service Temperature: 1000°F.

C. Vapor Retarder Jacket: ASJ/SSL conforming to ASTM C 1136 Type I, secured with self-sealing longitudinal laps and butt strips.

D. Field-Applied PVC Fitting Covers with Flexible Fiberglass Insulation: Proto Corporation 25/50 or Indoor/Outdoor, UV-resistant fittings, jacketing and accessories, white or colored. Fitting cover system shall consist of pre-molded, high-impact PVC materials with blanket type fiberglass wrap inserts. Blanket fiberglass wrap inserts shall have a thermal conductivity ('K') of 0.26 at 75°F mean temperature. Closures shall be stainless steel tacks, matching PVC tape, or PVC adhesive per manufacturer's recommendations.

E. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in pre-forming insulation to cover valves, elbows, tees, and flanges.

2.4 PIPE INSULATION (FLEXIBLE TYPE)

A. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Adhesive: As recommended by insulation material manufacturer.

B. Insulation (1 in. thickness and smaller) shall have a flame-spread index of less than 25 and a smoke-developed index of less than 50 as tested by ASTM E 84 and CAN/ULC S-102, "Method of Test for Surface Burning Characteristics of Building Materials".

2.5 FIRE RATED INSULATION

A. Wrap shall be fully tested against external fires (ASTM E 119/UL263), through penetration insulated piping fires (ASTM 814/UL1479), wall fires (ASTM E 119), and surface burning (ASTM E 84/UL723). Wrap for engine exhaust applications shall use two layers of 1-1/2 in. wrap. The interior layer shall be applied with a butt joint. The second layer shall be offset a minimum of six inches from the initial layer, with an overlap of three inches and the insulated pipe is banded with stainless steel straps.

B. Acceptable Manufacturers: John Mansville Firetemp Wrap, Certainteed FlameChek or approved equal.

2.6 FIELD-APPLIED JACKETS

A. Piping:

1. PVC Pipe Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming. Adhesive: As recommended by insulation material manufacturer. PVC Jacket Color: White.

2.7 COATINGS, MASTICS, ADHESIVES AND SEALANTS

A. Vapor Barrier Coatings: Used in conjunction with reinforcing mesh to coat insulation on below ambient services temperatures. Permeance shall be no greater than 0.08 perms at 45 mils dry as tested by ASTM F1249. Foster 30-65 Vapor Fas; Childers CP-34, or approved equal.

B. Lagging Adhesives: Used in conjunction with canvas or glass lagging cloth to protect equipment/piping indoors. Foster 30-36 Sealfas; Childers CP-50AMV1 Chil Seal, or approved equal.

C. Fiberglass Adhesive: Used bond low density fibrous insulation to metal surfaces. Shall meet ASTM C916 Type II. Foster 85-60; Childers CP-127, or approved equal.

D. Elastomeric Insulation Adhesive: Used to bond elastomeric insulation. Foster 85-75; Childers CP-82, or approved equal.

E. Elastomeric Insulation Coating: Water based coating used to protect outside of elastomeric insulation. Foster 30-65, Childers CP-34 or approved equal.

F. Insulation Joint Sealant: Used as a vapor sealant on below ambient piping with polyisocyanurate and cellular glass insulation. Foster 95-50; Childers CP-76, or approved equal.

2.8 PIPE SUPPORT INSULATION INSERTS

A. 20 lbs./cu. ft. molded fiberglass, for -120°F to +450°F service temperature, non-combustible, 0.30 thermal conductivity (k), same thickness as pipe insulation.

B. Acceptable Manufacturers: Hamfab "H" Block, or approved equal.

2.9 MATERIALS AND SCHEDULES

A. See Exhibits at the end of this section.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes, and industry standards.

B. Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation. No glass fibers shall be exposed to the air.

C. All pipe insulation shall be continuous through hangers, sleeves, walls, ceiling, floor, or roof openings, unless not allowed by fire stop system. Refer to Sections 220500, "Basic Plumbing Requirements" and 221010, "Piping Systems and Accessories" for firestop systems.

D. Provide thermal insulation on clean, dry surfaces and after piping and equipment (as applicable) have been tested. Do not cover pipe joints with insulation until required tests are completed.

E. All cold surfaces that may "sweat" must be insulated. Vapor barrier must be maintained; insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation. Cover valves, fittings and similar items in each piping system with insulation as applied to adjoining pipe run. Extra care must be taken on piping appurtenances to insure a tight fit to the piping system. For piping systems with fluid temperatures below ambient, all vapor retarder jacket (ASJ) seams must be coated with vapor barrier coating. All associated elbows, fittings, valves, etc. must be coated with vapor barrier coating and reinforcing mesh to prevent moisture ingress. Valve extension stems require Elastomeric insulation that is tight fitting to the adjoining fiberglass system insulation. Pumps, strainers, drain valves, etc. must be totally encapsulated with Elastomeric insulation.

F. Items such as manholes, handholds, clean-outs, plugged connections, pet cocks, air vents, ASME stamp, and manufacturers' nameplates, may be left un-insulated unless omitting insulation would cause a condensation problem. When such is the case, appropriate tagging shall be provided to identify the presence of these items. Provide neatly beveled edges at interruptions of insulation.

G. Provide protective insulation as required to prevent personal injury.

H. All pipes shall be individually insulated.

I. If any insulation material becomes wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site.

J. All exposed surfaces shall be white, unless noted otherwise.

3.2 PIPE INSULATION

A. Insulate piping systems including fittings, valves, flanges, unions, strainers, and other attachments installed in piping system, whether exposed or concealed including all piping, valves, etc. within meter/backflow preventer enclosure.

B. Insulation installed on piping operating below ambient temperatures must have a continuous vapor retarder. All joints, seams and fittings must be sealed. Insulation shall be continuous through hangers on all water piping and storm water piping.

C. Hanger Shields: Refer to Section 221010 "Piping Systems and Accessories".

D. Hanger shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed as required between the pipe and the insulation shields. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required.

1. Pre-Insulated Type: Butt insulation to hanger shields and apply a wet coat of vapor barrier cement to the joints and seal with 3 in. wide vapor barrier tape.

2. Field Insulated Type: Provide Hamfab Co. "H" blocks per manufacturers recommended spacing between pipe and shield.

3. Tape shields to insulation.

E. Joints in section pipe covering made as follows:

1. All ends must be firmly butted and secured with appropriate butt-strip material. On high-temperature piping, double layering with staggered joints may be appropriate. When double layering, the inner layer should not be jacketed.

2. Standard: Longitudinal laps and butt joint sealing strips cemented with white vapor barrier coating, or factory supplied pressure sensitive adhesive lap seal.

3. Vapor Barrier: For cold services, Longitudinal laps and 4 in. vapor barrier strip at butt joints shall be sealed with white vapor barrier coating. Seal ends of pipe insulation at valves, flanges, and fittings with white vapor barrier coating.

F. Fittings, Valves and Flanges:

1. Domestic Hot and Cold Water: Premolded fitting insulation of the same material and thickness as the adjacent pipe insulation.

2. White PVC jacketing, with continuous solvent weld of all seams. Tape all fittings.

G. Flexible Pipe Insulation:

1. Split longitudinal joint and seal with adhesive.

2. Fittings made from miter-cut pieces properly sealed with adhesive, or elbows may be continuous.

H. Apply PVC jacket where indicated, with 1 in. overlap at longitudinal seams and end joints. Seal with manufacturers recommended adhesive.

I. Piping in exterior walls, spaces, overhangs, attics, or where subject to freezing: Insulate pipe with double the thickness called for. Piping in wall chases: In addition to the above, pack chase with loose glass fiber insulation.

J. Provide insulation on exposed hot and cold plumbing piping to within 18 in. of fixture or equipment connection.

K. Insulate exposed domestic water and waste piping for plumbing fixtures designated for use by the handicapped.

EXHIBIT "I" - PIPE INSULATION MATERIALS
(Notes at end of Exhibit "I")

SERVICE	INSULATION MATERIAL	THICKNESS	REMARKS
Domestic cold water	Glass fiber	1-1/2 in. and larger: 1 in. 1-1/4 in. and smaller: 1/2 in.	SEE NOTES 1, 2
Domestic cold water (buried)	Flexible	1-1/2 in. and larger: 1 in. 1-1/4 in. and smaller: 1/2 in.	
Non potable cold water	Glass fiber	1-1/2 in. and larger: 1 in. 1-1/4 in. and smaller: 1/2 in.	SEE NOTE 2
Domestic hot, tempered and circulation water (105°F - 140°F)	Glass fiber	1-1/2 in. and larger: 1-1/2 in. 1-1/4 in. and smaller: 1 in.	SEE NOTES 1, 2
Domestic hot, tempered and circulation water (105°F - 140°F) (buried)	Flexible	1-1/2 in. and larger: 1-1/2 in. 1-1/4 in. and smaller: 1 in.	
Domestic hot, tempered and circulation water (141°F - 200°F)	Glass fiber	1-1/2 in. and larger: 2 in. 1-1/4 in. and smaller: 1-1/2 in.	SEE NOTES 1
AC unit drains, overflows and indirect waste piping associated with any HVAC equipment	Glass fiber Flexible	All sizes: 1/2 in.	Not required for exposed PVC drains SEE NOTE 2
Storm and secondary storm water	Glass fiber	All sizes: 1 in.	Insulate body of drain and storm water piping, horizontal and vertical, down to connection below ground floor slab or in crawl space SEE NOTE 4
Sanitary and waste	Glass fiber	All sizes: 1/2 in.	SEE NOTE 3, 4

NOTES FOR EXHIBIT I:

NOTE 1: Exposed insulation at kitchen, laundry, and sterilizer equipment shall be covered with PVC jacket.

NOTE 2: Flexible allowed in 1/2 in. thickness only.

NOTE 3: Insulation on sanitary and waste piping located within plumbing chases and crawl spaces are not required.

NOTE 4: When PVC piping is installed for storm, sanitary and vent piping within return air plenums, the piping shall be insulated and enclosed in materials listed and labeled for installation within a plenum.

END OF SECTION

SECTION 221010 - PIPING SYSTEMS AND ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUBMITTALS

A. Provide a schedule of pipe materials, fittings and connections.

B. Provide a detailed matrix listing the specific UL approved firestop system assembly to be used for each type of piping provided and each type of construction to be penetrated along with all associated UL assembly details.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pipe and fittings shall be new, marked with manufacturer's name and comply with applicable ASTM and ANSI Standards.

B. All items here-in used to convey water for potable use shall be lead free in accordance with NSF, Standard 61, Section 9 - Standard for Drinking Water and Lavatory Faucets and NSF Standard 372 - Maximum Lead Requirements. Compliance shall be via third party testing and certification.

2.2 STEEL PIPING AND FITTINGS

A. Pipe: ASTM A53, or ASTM A106 seamless, Schedule 40 or Schedule 80 weight; black or galvanized finish as called for; ends chamfered for welding or grooved for grooved mechanical connections.

B. Fittings: Same material and pressure class as adjoining pipe.

1. Welded fittings: Factory forged, seamless construction, butt weld type chamfered ends. Where branch connections are two or more sizes smaller than main size, use of "Weldolets", "Thredolets" or "Sockolets" acceptable. Mitered elbows, "shaped" nipples, and job fabricated reductions not acceptable unless specifically called for. Socket weld type, 2000 psi wp, where called for.

2. Threaded fittings: Cast or malleable iron, black or galvanized, as called for; drainage type where called for; UL listed and FM approved for fire protection systems. Street type 45° and 90° elbows are not acceptable.

C. Flanges, Unions, and Couplings:

1. Threaded Connections:

a. Flanges: Cast iron companion type; for sizes 2-1/2 in. and larger.

b. Unions: Malleable iron, bronze to iron seat, 300 lb. wwp; for sizes 2 in. and smaller.

c. Couplings: Malleable iron. Steel thread protectors are not acceptable as couplings.

2. Welded Connections:

a. Flanges: Welding neck type. Slip-on type not allowed unless noted and shall not be installed in conjunction with butterfly valves.

3. Grooved Mechanical Connections:

a. Couplings: Ductile iron, ASTM A536, with painted coating, designed for rolled grooved piping, hot dipped galvanized finish were called for.

b. Gaskets: Grade "E" EPDM synthetic rubber, -30°F to 230°F temperature range, suitable for water service.

c. Bolts and Nuts: Heat treated, hex head carbon steel, ASTM A183, cadmium plated or zinc electroplated.

d. Fittings: Elbows, tees, laterals, reducers, adapters as required. Same construction as couplings.

e. Design Equipment: Victaulic, flexible system, Style 77 couplings.

f. Acceptable Manufacturers: Grinnell, Gruvlok, Victaulic.

D. Gauge and Instrument Connections: Nipples and plugs for adapting gauges and instruments to piping system shall be IPS brass.

E. Base Elbows:

1. Cast iron or steel type, flange connections; Crane 500 or equivalent made from welding elbows, with welded pipe support and steel base. Reducing elbows where necessary.

Elbow Size	Support Size	Base Plate
Up to 3 in.	1-1/4 in.	6 in. x 6 in. x 1/4 in.
4 in. to 6 in.	2-1/2 in.	8 in. x 8 in. x 1/4 in.
8 in. and larger	6 in.	14 in. x 14 in. x 5/16 in.

2. Anchor bolt holes in each corner of base for securely bolting to floor or concrete base; minimum 3/4 in. bolts.

2.3 STEEL PIPING AND FITTINGS - PRESS CONNECT FITTINGS

A. Piping Standard: Black steel piping shall conform to ASTM A53 or ASTM A106 seamless, Schedule 40 weight pipe.

B. Fittings: Listed in accordance with ANSI LC4/CSA 6.32.

1. For natural gas service, -40 deg. F to 180 deg F at 125 PSI.

2. Sizes 1/2 inch through 4 inch, Schedule 40.

3. Schedule 40 steel fittings with zinc/nickel coating for use with IPS schedule 40 carbon steel, pipe conforming to ASTM A53 or ASTM A106. Fittings shall have an HNBR sealing element, 420 stainless steel grip ring, separator ring and "Smart Connect" (SC) feature.

C. Design Make: Viega Mega Press G System.

D. Acceptable Manufacturer: Viega.

2.4 COPPER TUBE AND FITTINGS

A. Pipe: ASTM B88; Type K or L, hard temper. Soft temper only as called for. Plans show copper tube sizes.

B. Fittings: Wrought copper and copper alloy, ASME B16.22 or cast copper alloy, ASME B16.18; solder end connections.

C. Joints: Comply with the requirements of ASTM B828.

D. Unions and Flanges: 2 in. and smaller use unions, solder type, cast bronze, ground joint, 150 lb. swp: 2-1/2 in. and over use flanges, cast bronze, companion type, ASME drilled, solder connection, 150 lb. swp.

E. Flux Materials: Flux shall comply with ASTM B813 and the provisions of the New York State Plumbing Code.

F. Solder Materials: No-lead solder, using alloys made from tin, copper, silver and nickel. Harris, Inc., "Stay-Safe 50" and "Bright", Engelhard "Silvabright 100", Canfield "Watersafe" or approved equal.

G. Brazing Materials: Class BcuP-5 for brazing copper to brass, bronze to copper. Harris, Inc. "Stay-Silv 15" or approved equal.

2.5 COPPER TUBE AND FITTINGS - PRESS FITTINGS

A. Tubing Standard: Copper tubing shall conform to ASTM B75 or ASTM B88.

B. Fitting Standard: Copper fittings shall conform to ASME B16.18, ASME B16.22, or ASME B16.26.

C. Press Fittings: 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.

D. Acceptable Manufacturers: Apollo, Mueller, Nibco, Viega.

2.6 CPVC DOMESTIC WATER PIPING

A. All pipe and fittings shall be manufactured from CPVC compound with a cell class of 24448 for pipe and 23447 for fittings as per ASTM D-1784; shall conform to National Sanitation Foundation (NSF) Standards 6 and 14; and shall be intended for use in hot and cold domestic water distribution systems.

B. 1/2 in. through 2 in. Sizes: CPVC Copper Tube Size, standard dimension ratio (SDR) 11 conforming to ASTM D-2846. Transition fittings shall have brass male or female connections with integral CPVC socket connections; Charlotte Pipe and Foundry Co. FlowGuard Gold or approved equal.

C. 3 in. through 6 in. Sizes: CPVC Schedule 80 iron pipe size (IPS) conforming to ASTM F-441. Socket type fittings shall conform to ASTM F-439. Transition to metal piping shall be made using 150# flanged connections.

D. All pipe and fittings shall be produced by a single manufacturer and installed in accordance with manufacturer's recommendations and local Code requirements. Piping shall be installed using approved solvent cement conforming to ASTM F-493 and primer conforming to ASTM F-656 and in accordance with manufacturer's recommendations.

2.7 PEX DOMESTIC WATER PIPING

A. Pipe: Cross-linked, high density, polyethylene tubing for potable water. ASTM F-876/F-877; ANSI/NSF 61. Plans show nominal tube sizes.

B. Manifolds: Copper manifold with sweat ends and 24-3/4 in. outlets on 3 in. centers. Provide reducing couplings as required for individual outlets.

C. Valves: Brass body ball valves with sweat X PEX compression ends rated for 250 psi and 250°F. Provide crimp ring for PEX compression connections.

D. Acceptable Manufacturers: Wirsbo, Viega, Zurn or approved equal.

2.8 COPPER TUBE AND FITTINGS - GROOVED MECHANICAL CONNECTIONS

A. Pipe: ASTM B88, Type K or L, hard temper.

B. Fittings: Wrought copper, roll grooved mechanical connections, ASTM B-75, ANSI B16.22 for 4 in. size. Cast bronze, rolled grooved mechanical connections, ASTM B-584, ANSI B16.18 for sizes 5 in. - 8 in.

C. Couplings: Ductile iron, ASTM A-536, with copper colored alkyd enamel finish, designed for rolled grooved piping.

D. Gaskets: Grade "E" EPDM synthetic rubber, copper color coded, -30°F to 230°F temperature range, suitable for water service.

E. Bolts and Nuts: Heat treated, hex head carbon steel, ASTM A183, cadmium plated or zinc electroplated finish.

F. Design Equipment: Victaulic Style 606 couplings.

G. Acceptable Manufacturers: Grinnell, Gruvlok, Victaulic.

2.9 COPPER DRAINAGE TUBE AND FITTINGS

A. Pipe: ASTM B306, Type DWV, hard temper.

1. Copper not allowed for urinal waste.

B. Fittings: Wrought copper, ANSI B16.29 or cast bronze, ANSI B16.23; solder end connections.

C. Flux Materials: Flux shall comply with ASTM B813 and the provisions of the New York State Plumbing Code.

D. Solder Materials: No lead solder, using alloys made from tin, copper, silver and nickel.

E. Acceptable Manufacturers: Harris, Inc., "Stay-Safe 50" and "Bright", Engelhard "Silvabright 100", Canfield "Watersafe", or approved equal.

2.10 BRASS PIPE AND FITTINGS

A. Piping: ASTM B43, semi-annealed, red brass containing not less than 85% copper; chrome plated where called for.

B. Fittings: Cast brass, sps, malleable iron pattern, reinforced corresponding to weight of pipe; chrome plated with high polished finish where called for.

2.11 HUB AND SPIGOT CAST IRON SOIL PIPE AND FITTINGS

A. Pipe: ASTM A74 service weight cast iron, bitumen coated.

B. Fittings: Cast iron, service weight, hub and spigot, drainage pattern, bitumen coated.

C. Connections: ASTM C564 neoprene gaskets and lubricant.

D. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.12 NO-HUB CAST IRON SOIL PIPE AND FITTINGS

A. Pipe: ASTM A888, CISPI Standard 301, no-hub cast iron, bitumen coated.

1. For above grade only.

B. Fittings: Cast iron, no-hub drainage pattern, bitumen coated.

C. Couplings:

1. 1-1/2 in. to 2 in.: CISPI standard 310 with 300 series stainless steel corrugated shield and clamp assembly with ASTM C564 neoprene sealing sleeve (or) same as specified for 3 in. and larger.

2. 3 in. and Larger: 24 gauge, Type 304 stainless steel housing clamp assembly with ASTM C564 neoprene sealing sleeve, 60 in. lbs. minimum torque rating, shall meet requirements of pipe manufacturer and shall be compatible with specified pipe. Acceptable Manufacturers: Clamp-All Coupling System, Tyler "Wide Body", Husky "Series 2000", Mission "Heavy Weight", Ideal Tridon "HD" heavy duty or approved equal.

D. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.13 PVC SOLID WALL PIPE AND FITTINGS - DWV SYSTEM

A. Pipe: PVC Schedule 40 solid wall pipe, iron pipe size conforming to ASTM D1785 and ASTM D2665. Pipe shall be manufactured from PVC compounds as identified in ASTM D1784. Both pipe and fittings shall conform to National Sanitation Foundation Standard 14.

B. Fittings: Type DWV, socket type conforming to ASTM D2665. Fittings shall be manufactured from PVC compounds as identified in ASTM D1784. Solvent cement joints shall be made utilizing a two-step process with primer manufactured for thermoplastic piping and solvent cement conforming to ASTM D2564.

2.14 SPECIAL FITTINGS

A. Cast Iron to Lead Pipe: Red brass ferrules and wiped joints. Caulk ferrule into cast iron hub.

B. Copper to Cast Iron: Cast bronze, cast iron to sweat adapter.

C. Copper to Steel Piping:

1. Cast bronze copper to iron male or female adapter with shoulder for drainage piping only.

2. Dielectric pipefittings.

D. Steel to Cast Iron: Cast iron soil pipe connector with spigot and IPS male thread end (Manhoff fittings).

E. No-Hub, Cast Iron, Glass, Polypropylene or High Silicon Cast Iron: Proper adapter to piping being connected.

F. Cast Iron and PVC Sovent: Aerators and deaerators as manufactured by Conine Manufacturing Co., Inc.

2.15 DIELECTRIC PIPE FITTINGS

A. Description: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

B. Unions: Factory fabricated, for 250 psi minimum working pressure at 180°F, threaded or solder ends, insulating material suitable for system fluid, pressure and temperature.

C. Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum pressure to suit system fluid pressures and temperatures with flange insulation kits and bolt sleeves.

D. Acceptable Manufacturers: EPCO, Capitol Manufacturing, Watts or approved equal.

2.16 HANGERS, INSERTS AND SUPPORTS

A. Hangers, Inserts, Clamps: B-Line, Grinnell, Michigan Hanger, PHD Manufacturing.

B. Hangers:

1. Adjustable, wrought malleable iron or steel with electroplated zinc or cadmium finish. PVC coated where in contact with copper piping.

2. Adjustable ring type where piping is installed directly on hanger for piping 3 in. and smaller.

3. Adjustable steel clevis type for piping 4 in. and larger.

4. Nuts, washers and rods with electroplated zinc or cadmium finish.

5. Provide hot dipped galvanized finish for hangers and accessories installed in exterior locations and interior areas with moist environment conditions such as pools, pool filter rooms, areaways, garages and similar areas.

C. Spacing Schedule:

Pipe Size	Steel	Copper	Plastic	Cast Iron	Rod Size
3/4 in. to 1 in.	8 ft.	6 ft.	3 ft.	Each	3/8 in.
1-1/4 in. to 2 in.	10 ft.	6 ft.	3 ft.	Horizontal	3/8 in.
2-1/2 in. to 4 in.	12 ft.	10 ft.	4 ft.	Joint 5 ft.	1/2 in.
5 in. and over	12 ft.	10 ft.	4 ft.	Maximum	5/8 in.
8 in.	12 ft.	10 ft.	4 ft.	O.C.	3/4 in.
Over 8 in.	To suit loading conditions.				

D. Cast Iron No-Hub Supports:

1. In accordance with manufacturer's recommendations.

2. Vertical piping supported at each stack base, at each floor and 15 ft. on center, maximum. Freestanding vertical pipe should be adequately staked or braced during construction to maintain alignment. Bases of stacks shall be supported on

concrete, brick laid in cement mortar, metal brackets attached to the building construction or by other methods approved by the Owner's Representative.

3. Horizontal piping supported within 24 in. each side of the coupling joint at 10 ft. intervals for 10 ft. pipe lengths and at 5 ft. intervals for 5 ft. pipe lengths. Supports or hangers placed to maintain alignment and grade with provision made to prevent shear. Greater than 3 in. diameter pipe braced at changes of direction to prevent horizontal movement.

E. Beam Attachments:

1. C-Clamp style, locknut, restraining strap, electroplated finish, UL listed, FM approved for pipe sizes 2 in. and smaller.

2. Center loaded style with clamp attachments that engage both edges of beam, electroplated finish, UL listed, FM approved, for pipe sizes larger than 2 in., refer to "Supports" for additional requirements.

F. Inserts: Carbon steel body and square insert nut, galvanized finish, maximum loading 1300 lbs., for 3/8 in. to 3/4 in. rod sizes, reinforcing rods on both sides, MSS-SP-69 Type 19 or approved equal.

G. Supports:

1. Provide intermediate structural steel members where required for hanger attachment. Members shall span across the bar joists at panel points of joists. Secure member to structure. Select size of members based on a minimum factor of safety of four.

2. For Weights Under 1000 lbs.: "Drill-In" inserts, "U" shaped Channel, beam clamps or other structurally reviewed support. The factor of safety shall be at least four. Follow manufacturer's recommendations.

3. For Weights Above 1000 lbs.: Drill through floor slabs and provide flat flush plate welded to top of rod or provide additional "Drill-In" inserts and hangers to reduce load per hanger below 1000 lbs.

4. For Metal Decks: Drill hole through for hanger rods and imbed a welded plate in concrete or use devices designed for this application, with a safety factor of four.

5. For Wood Construction: Provide hangers and supports designed for attachment to wood construction.

6. Acceptable Manufacturers: Hilti, ITW Ramset, Phillips "Red Head" or approved equal.

H. Trapeze Hangers:

1. For plumbing systems only.

2. Hangers shall be supported with rod sized with a safety factor of four.

3. May be manufactured type "U" shaped channel, or suitable angle iron or channel. Round off all sharp edges.

4. Securely fasten piping to trapeze with "U" bolt or pipe clamps, dissimilar metals shall not touch, use isolation gaskets, similar to HoldRite strut-mounted cushion clamps. Fasten piping to trapeze at every third support, except uninsulated piping which shall be fastened at every support using strut-mounted cushion clamps.

5. Acceptable Manufacturers: B-Line, HoldRite, Kindorf, Unistrut or approved equal.

I. Roof Pipe Supports - Deck Mounted Rail:

1. Raised cant for insulated roof, heavy-gauge galvanized steel with integral base, 2 x 4 pressure treated wood nailer, removable galvanized steel counter flashing.

2. Steel channel track, roller assembly and accessories, adjustable, locking devices in roller assembly, all parts galvanized except painted cast iron roller.

3. Length as required for quantity of pipes to be supported. Anchor to roof deck per manufacturer.

4. Acceptable Manufacturers: Pate #PRS-5A or approved equal.

J. Roof Pipe Supports - Fixed and Adjustable Pillow Block Style:

1. Pipe support for placement on roof surface with base perforated for drainage. Provide pipe anchor strap option and manufacturer's support pad or roofing manufacturer's recommended slip sheet below support. Support models shall be selected based on total pipe O.D. and pipe weight operating full. All polycarbonate materials shall be UV stabilized.

2. Fixed Height Pipe Stand: For bare piping up to 5 in. nominal or insulated piping up to 6 in. outside diameter. Polycarbonate resin base plate with fixed height self-lubricating polycarbonate roller supported by glass-filled nylon or stainless steel rod. Miro Industries Model R Series.

3. Adjustable Height Pipe Stand with Polycarbonate Base: For bare piping up to 5 in. nominal or insulated piping up to 6 in. outside diameter. Polycarbonate base plate with adjustable stainless steel all thread rod vertical supports, polycarbonate roller on stainless steel rod. Miro Industries Model RAH Series.

4. Adjustable Height Pipe Stand with Metal Base: For bare piping 4 in. to 6 in. nominal or insulated piping up to 7 in. outside diameter. 12 in. by 16 in. wide hot dipped galvanized steel base plate with adjustable stainless steel all thread rod vertical supports, polycarbonate roller on stainless steel rod. Miro Industries Model RAH Series.

5. Pipe Hanger Stand with Polycarbonate Base: For bare piping up to 2-1/2 in. nominal or insulated piping up to 3-1/2 in. outside diameter. 9 in. by 15 in. wide

polycarbonate resin base plate with adjustable stainless steel all thread rod vertical supports, galvanized top strut with clevis hanger suspended on stainless steel all thread rod. Miro Industries Model 2.5-SB-H Series.

6. Adjustable Height Pipe Stand with Metal Base: For bare piping up to 6 in. nominal or insulated piping up to 7-1/2 in. outside diameter. Two (2) 8 in. by 14 in. wide hot dipped galvanized steel base plates, with adjustable height galvanized braced strut assembly with clevis hanger suspended on a stainless steel all thread rod. Miro Industries Model 6-H Series.

K. Cabinet Pipe Space Supports:

1. Piping below casework countertops within space behind cabinet shall be supported using continuous slot metal channels with pipe clamps.

2. Acceptable Manufacturers: B-Line, Kindorf, Unistrut or approved equal.

L. Hanger Insulation Shields:

1. Hanger insulation shields shall be provided for all water and storm water piping. Hangers shall attach directly to pipe for all remaining services.

2. Piping 2 in. and Smaller: Pipe insulated with glass fiber insulation shall be protected at point of support by a sheet metal shield. Shield shall be #18 gauge, galvanized steel, minimum 120 degree arc, formed to fit insulation thickness and 12 in. long. Tape shields to pipe insulation.

3. Piping 3 in. and Larger: Pipe insulated with glass fiber insulation shall be protected at point of support by a sheet metal shield and pipe support insulation insert(s) between pipe and hanger. Shield shall be #18 gauge, galvanized steel, minimum 120 degree arc, formed to fit insulation thickness and 12 in. long. Tape shields to pipe insulation. Provide temporary blocking to maintain proper spacing for insulation.

M. Provide continuous support for unpigmented polypropylene piping.

N. PEX tubing supports shall comply with manufacturer's recommendations, but shall be no more than 2 ft. - 0 in. on center.

O. Piping systems with material not listed above shall be supported and protected in accordance with manufacturer's recommendations.

2.17 PIPING ACCESSORIES

A. Escutcheon Plates: Steel or cast brass, split hinge type with setscrew, high plates where required for extended sleeves. Chrome plated in finished areas and at plumbing fixtures.

B. All cleanout plugs, bushings and nipples, required for instruments and gauges shall be brass.

C. Hubless cast iron fitting restraints shall be Holdrite Series #117 or approved equal.

2.18 SLEEVES

A. Standard Type:

1. Schedule 40 black steel pipe sleeves for structural surfaces, two pipe sizes larger than the pipe, and as recommended by the sealing element manufacturer. Provide full circle water stop collar for sleeves located within below grade walls, wet wells and waterproofed surfaces. The collar shall be fabricated from steel plate and welded to the sleeve around its entire circumference.

2. Schedule 40 PVC sleeves or sheet metal sleeves for nonstructural surfaces and existing construction. Sheet metal sleeves shall be 18 gauge minimum and braced to prevent collapsing.

2.19 SEALING ELEMENTS

A. Expanding neoprene link type, watertight seal consisting of interlocking links with zinc plated bolts.

1. Acceptable Manufacturers: Thunderline "Link-Seal" Series 200, 300 or 400, Pyropac, Calipco.

2.20 FIRESTOP SYSTEM FOR OPENINGS THROUGH FIRE RATED WALL AND FLOOR ASSEMBLIES

A. Materials for firestopping seals shall be listed by an approved independent testing laboratory for "Through-Penetration Firestop Systems". The system shall meet the standard fire test for Through-Penetration Firestop Systems designated ASTM E814. Firestop system seals shall be provided at locations where piping pass through fire rated wall, floor/ceiling, or ceiling/roof assembly. Minimum required fire resistant ratings of the assembly shall be maintained by the Firestop System. Installation shall conform with the manufacturer's recommendations and other requirements necessary to meet the testing laboratory's listing for the specific installation.

2.21 STACK SLEEVE

A. Cast iron body with caulking recess, flashing clamp and under deck clamp.

B. Acceptable Manufacturers: Jay R. Smith Series 1720, Zurn, Wade.

2.22 STRAINERS

A. Description: Y-Pattern, self-cleaning, except where otherwise indicated, full size of connecting piping, Type 304 stainless steel screens, 125 lb. SWP, unless otherwise indicated.

B. Copper Piping 2-1/2 in. and Smaller: Lead free, cast bronze body, threaded ends, tapped retainer cap with closure plug, 20 mesh screen, Watts #LF777S.

C. Steel Piping 2-1/2 in. and Smaller: Iron body, threaded ends, tapped retainer cap with closure plug, 20 mesh screen, Watts #77S

D. Piping 3 in. and Larger, Cold Water Applications: Lead free, cast iron body, flanged ends, standard screen openings, FDA approved epoxy coating, tapped retainer cap and gasket with closure plug; Watts #77F-DI-FDA-125.

E. Fuel Oil Strainers 2 in. and Smaller: Line strainer, top cleanout, cast iron body and cap, malleable iron yoke, 50 psi operating pressure, 24 mesh stainless steel cage and basket for #2 fuel oil, female threaded ends, UL listed; Morrison Figure #286-U.

2.23 STAINLESS STEEL FLUE PIPE

A. Double wall stainless steel flue pipe shall consist of 430 stainless steel outer jacket, 1/2 in. air space, AL-29-4C inner jacket. Flue piping shall be tested and listed to UL1738, for Categories III and IV. All joints shall be equipped with a factory-applied seal.

B. Acceptable Manufacturers: Heatfab, Precision Vent, Selkirk.

2.24 PIPING MATERIALS AND SCHEDULE

A. See Exhibit "A", "Schedule of Piping Materials" at end of this Section for (Plumbing) piping.

B. See Exhibit "B", "Testing" at end of this Section.

PART 3 - EXECUTION

3.1 EQUIPMENT AND SYSTEMS

A. Install equipment and systems in accordance with provisions of each applicable Section of these Specifications, and Local/State Codes/Regulations having jurisdiction. Accurately establish grade and elevation of piping before setting sleeves. Install piping without springing or forcing, except where specifically called for, making proper allowance for expansion and anchoring. Changes in sizes shall be made with reducing fittings. Reducing couplings are not acceptable. Arrange piping at equipment with necessary offsets, unions, flanges, and valves, to allow for easy part removal and maintenance. Offset piping and change elevation as required to coordinate with other work. Avoid contact with other mechanical or electrical systems. Provide adequate means of draining and venting units, risers, circuits and systems. Conceal piping unless otherwise called for. Copper tubing shall be cut with a wheeled tubing cutter or other approved copper tubing cutter tool. The tubing must be cut square to permit proper joining with the fittings. Ream pipes after cutting and clean before installing. Cap or plug equipment and pipe openings during construction. Install piping parallel with lines of building, properly spaced to provide clearance for insulation. Make changes in direction and branch connections with fittings. Do not install valves, unions and flanges in inaccessible locations. Materials within a system and between systems shall be consistent. If this is not possible, install dielectric fittings.

3.2 PIPING OVER ELECTRICAL EQUIPMENT

A. Contractor shall route piping to avoid installation directly over electric equipment, including, but not limited to panels, transformers, disconnects, starters, motor control center, adjustable speed drives and fused switches.

B. Piping shall not be installed in the dedicated electric and working space as defined by NEC 110. Dedicated electrical space is generally equal to the depth and width of electrical equipment, and extends 6 ft. above the electrical equipment, or to a structural ceiling. Dedicated working space is a minimum of 30 in. wide or the width of equipment (whichever is larger) a minimum of 6 ft.-6 in. tall, with a depth of 3ft. to 9 ft. depending on the voltage.

3.3 HANGERS, INSERTS AND SUPPORTS

A. Piping shall not be supported by wires, band iron, chains, from other piping, or by vertical expansion bolts. Support piping with individual hangers from concrete inserts, wood construction, welded supports, or beams clamps of proper configuration and loading design requirements for each location; replace if not suitable. Follow manufacturer's safe loading recommendations. Suspend with rods of sufficient length for swing and of size called for, using four (4) nuts per rod. Provide additional structural steel members, having one coat rustproof paint, where required for proper support. Provide oversized hangers where insulation/supports must pass between pipe and hanger. Provide continuous support or extra supports for plastic piping per manufacturer's requirements. Hangers, when attached to joists, shall only be placed at the top or bottom chord panel point. Only concentric type hangers are permissible on piping larger that 2-1/2 in.; "C" types are permitted for piping 2 in. and smaller on joists. Provide riser clamps for each riser at each floor. Use trapeze hangers where a group of piping can be installed.

B. Provide a pipe hanger within 12 inches of pipe unions and piping connections to equipment, in order to facilitate disconnections of piping without pipe sagging.

3.4 PIPE CONNECTIONS

A. No-Lead Solder Connections: Nonacid flux and clean off excess flux and solder.

B. Copper Press Connections: Copper press fittings shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

C. Steel Press Connections:

1. Natural Gas Systems: Sealing elements shall be verified for the intended use. Pipe ends shall be cut on a right angle (square) to the pipe. Pipe ends shall be reamed and all paint, lacquer, grease, oil, and dirt shall be removed from the pipe end with an abrasive cloth, or with a Ridgid MegaPress pipe end prep tool. Visually examine each fitting sealing element to ensure there is no damage. Insert the pipe fully into the fitting and mark the pipe wall at the face of the fitting. Always examine the pipe to ensure it is fully inserted into the fitting prior to pressing the joint. Steel Press fittings shall be installed using Ridgid, MegaPress Tools. Steel Press fittings shall be installed according to the most current edition of the manufacturer's installation guidelines. Installers shall be trained by a manufacturer representative on proper installation procedures.

2. Testing: After Steel Press fittings have been installed a "two step test" shall be followed. Utilizing air or, dry nitrogen, pressurize the system between 5 psi and 45 psi. Check the pressure gauge for pressure loss. If the system does not hold pressure, inspect entire system and check for un-pressed fittings. Should un-pressed fittings be identified, ensure the pipe is fully inserted into the fitting and properly marked prior to pressing the joint. After appropriate repairs have been made, test the system per local code, or specification requirements, not to exceed 200 psig.

D. Brazed Connections: Make joints with silver brazing alloy in accordance with manufacturer's instructions. Remove working parts of valves before applying heat.

E. Threaded Connections: Clean out tapering threads, made up with pipe dope; screwed until tight connection. Pipe dope must be specifically selected for each application.

F. Flanged Joints: Select appropriate gasket material, size, type and thickness for service applications. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Dielectric Pipe Fittings: Provide dielectric unions at ALL equipment connections where dissimilar metals meet. In addition, provide dielectric unions in all open type piping systems (condensing water, domestic water, etc.) where dissimilar metals are to be joined.

H. Grooved Mechanical Joints: Pipe to be prepared in accordance with the latest manufacturer's grooving specification. Use manufacturer's recommended grooving tools. Pipe shall be checked to be sure it is free of indentations, projections; weld seams or roll marks on the exterior of the pipe over the entire gasket seating area. Pipe ends are to be square cut. Lubricant shall be applied to gasket and/or pipe ends and housing interiors to eliminate pinching the gasket.

I. Solvent-Cement Plastic Piping 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. Apply primer.

2. CPVC Piping: Join according to ASTM D 2846.

3. PVC Piping: Join according to ASTM D 2855.

3.5 WELDING

A. Welding shall be performed in compliance with the welding procedure specifications prepared by the National Certified Pipe Welding Bureau. Welded pipe fabricated by certified welder. Contractor shall submit proof of current certification of each welder if requested by Owner. Use full-length pipe where possible; minimum distance between welds, 18 in. on straight runs. Welds must be at least full thickness of pipe inside smooth and remove cutting beads, slag and excess material at joints; chamfer ends. Minimum gap 1/8 in., maximum 1/4 in., for butt welds. Overlaps on position and bench welds to be not less than 3/4 in. One internal pass and one external pass minimum required on slip-

on flanges. Do not apply heat to rectify distorted pipe due to concentrated welding; replace distorted pipe.

B. When welding galvanized pipe, apply cold galvanizing on joint following welding.

3.6 SLEEVES

A. Provide for pipes passing through floors, walls or ceilings. Not required for floors that are core-drilled, except where floor is waterproofed.

B. Extend 1/8 in. above finished floor in finished areas. In above grade Mechanical Rooms and other areas with floor drains, use steel pipe sleeves 2 in. above floor.

C. Use steel pipe sleeves in bearing wall, structural slabs, beams and other structural surfaces, and where called for.

D. Sleeves shall be as small as practical, consistent with insulation, so as to preserve fire rating.

E. Fill abandoned sleeves with concrete.

F. Provide rubber grommet seals for pipes passing through ducts or air chambers or built-up housings.

3.7 SLEEVE PACKING

A. Seal void space at sleeves as follows:

1. Interior Locations: Firmly pack with fiberglass and caulk.

2. Exterior Walls and Below Grade Cored Holes: Use sealing element.

3. Cored Holes: Use sealing element.

4. Fire Rated, Partitions and Floor Slabs: Use fire rated sealing elements, materials and methods. Provide per manufacturer's instructions to maintain firestop.

5. Waterproofed Walls/Floors: Use waterproof sealing element, device or compound.

3.8 ESCUTCHEON PLATES

A. Provide polished chrome setscrew type escutcheon plates for all exposed piping passing through floors, walls or ceilings, in all rooms except in Boiler, Fan and Mechanical Rooms.

3.9 TESTS

A. Refer to Exhibit "B" at the end of this section for testing of Plumbing Systems.

B. Provide all necessary items to complete proper testing of work. Perform all testing in accordance with governing Codes, local utilities and other agencies having jurisdiction

and as specified. Pay all costs to perform tests. Perform all testing in a safe manner. Isolate existing systems.

C. Domestic Water:

1. Do not cover joints with insulation until required tests are completed and the Owner's Representative accepts the system.

2. Make leaks tight; no caulking permitted. Replace defective fittings, pipe or connections. Piping shall be tight and show no loss of pressure.

3. Air test not acceptable as final test.

4. Confirm in writing that tests and flushing have been conducted and successfully completed. Submit copy of the test report to Owner's Representative.

D. Sanitary and Storm:

1. There shall be no loss of water when testing interior piping.

2. Air test not acceptable as final test.

3. Should any leaks, defective joints or defective construction be detected in sewers and/or floors or walls of appurtenant structures, they shall be permanently stopped. Should any defective pipes, fitting or accessories be discovered they shall be removed and replaced at the Contractor's expense.

4. Confirm in writing that tests have been conducted and successfully completed. Submit copy of the test report to Owner's Representative.

3.10 DOMESTIC WATER PIPING CLEANING AND DISINFECTION

A. Cleaning and disinfecting shall be in accordance with requirements of New York State Department of Health and authority having jurisdiction. Prior to disinfecting, flush piping to remove any sediment and debris.

B. Clean and disinfect water distribution piping systems and parts of existing potable water systems that have been altered, extended or repaired.

C. After disinfection procedures, submit water samples in sterile bottles to an approved Department of Health Laboratory. Samples shall be proven equal to the water quality served to the public from the existing water supply system and acceptable to the Department of Health. Flush and disinfect all sections of pipe that fail the laboratory tests. Submit test results indicating water is potable.

3.11 PEX DOMESTIC WATER PIPING

A. Leave three (3) extra outlets on each manifold and cut manifolds to remove remaining outlets. Cap extra outlets for future use.

B. Accessories: Provide all required accessories including, but not limited to, bond supports, finished sleeves, strike plates, etc. as recommended by manufacturer.

3.12 CONNECTIONS TO SPECIAL EQUIPMENT

A. Kitchen Equipment:

1. Kitchen Equipment shall be furnished by others and set in place by others.

2. Provide all piping, stops, valves, traps and fittings.

3. Where exposed, provide chrome plated brass piping, valves, hangers, brackets and accessories.

4. Pipe relief valves to floor. Size and arrangement of pipe, traps, valves and fittings, as recommended by manufacturer of equipment.

3.13 PIPE LINE SIZING

A. Pipe sizes called for are to be maintained. Pipe size changes made only as reviewed by Owner's Representative. Where discrepancy in size occurs, the larger size shall be provided.

EXHIBIT "A" - PIPING MATERIALS (PLUMBING)
(Notes at end of Exhibit "A")

SERVICE	PIPE MATERIALS	FITTINGS	CONNECTIONS
Water service (2 in. and smaller)	SEE "UNDERGROUND PIPING AND ACCESSORIES" SECTION 221020		
Domestic water interior/hot, cold and circulating 3 in. and smaller	Type L copper	Wrought or cast copper	No-lead solder
	Type L copper	Wrought or cast copper	Press fit
	CPVC, SDR 11	Socket type	Solvent cement (SEE NOTE 6)
	PEX tubing	N/A	Compression
Domestic water interior/hot, cold and circulating 4 in. and larger			
	Type L copper	Wrought copper	Brazed
	Type L copper	Wrought or cast copper	Roll grooved mechanical type couplings
	CPVC, Schedule 80	Socket type	Solvent cement (SEE NOTE 6)
Sanitary, sanitary vent, grease waste and storm (buried)	SEE "UNDERGROUND PIPING AND ACCESSORIES" SECTION 221020		
Sanitary, sanitary vent and grease waste	Service weight cast iron soil pipe	Cast iron hub and spigot	Neoprene compression type gasket
	Service weight cast iron soil pipe	No hub	No hub neoprene gasket and stainless steel clamp assembly
	Type DWV copper	Wrought copper	No-lead solder (SEE NOTE 5)
	Schedule 40 PVC, solid wall	PVC, socket type	Solvent cement (SEE NOTE 4)

SERVICE	PIPE MATERIALS	FITTINGS	CONNECTIONS
Storm	Service weight cast iron soil pipe	Cast iron hub and spigot	Neoprene compression type gasket
	Service weight cast iron soil pipe	No hub	No hub neoprene gasket and stainless steel clamp assembly
	Schedule 40 PVC, solid wall	PVC, socket type	Solvent cement (SEE NOTE 4)
	Type DWV copper	Wrought copper	No-lead solder
Water heater intake piping	Schedule 40 PVC, solid wall	PVC, socket type	Solvent cement (SEE NOTE 4)
Water heater exhaust piping	AL-29-4C stainless steel (exhaust)	Stainless steel	Sealed closure system
Indirect waste	Type DWV copper	Wrought copper	No-lead solder
	Schedule 40 PVC, solid wall	PVC, socket type	Solvent cement (SEE NOTE 4)
	Schedule 40 PVC, foam core	PVC, socket type	Solvent cement (SEE NOTE 4)
Pump discharge	Schedule 40 galvanized steel	Galvanized cast iron drainage	Threaded
	Type L Copper	Wrought copper	No-lead solder
Natural gas (buried)	SEE "UNDERGROUND PIPING AND ACCESSORIES" SECTION 221020		
Natural gas (exterior above grade)	Schedule 40, black steel	Butt welded steel	Welded (SEE NOTE 2)
	Schedule 40, black steel	Malleable iron, 2 in. and smaller	Threaded (SEE NOTE 2)
	Schedule 40, black steel	Steel with zinc/nickel coating	Press fit
Natural gas (interior)	Schedule 40, black steel	Malleable iron, 2 in. and smaller	Threaded (SEE NOTE 2)
	Schedule 40, black steel	Butt welded steel, 2-1/2 in. and larger	Welded (SEE NOTE 2)

NOTES FOR EXHIBIT A:

NOTE 1: Provide ductile iron, double thickness cement - lined pipe and fittings up to the water meter inlet valve in accordance with the New York State Plumbing Code and Water Bureau Requirements. Pipe and fittings shall be flanged.

NOTE 2: Provide one coat of alkyd primer and two coats of exterior acrylic latex gloss enamel on exposed exterior and interior piping. Color as selected.

NOTE 3: For gas piping systems having operating pressure other than the standard 50 to 55 psig (or 160 psig for nitrogen), provide Type K copper for medical gas.

NOTE 4: PVC piping shall not be installed within return air plenums.

NOTE 5: Copper piping shall not be used for urinal waste piping.

NOTE 6: CPVC piping, copper tube size (SDR11) permitted for piping 2 in. and smaller. CPVC piping, Schedule 80 permitted for piping 3 in. and larger.

EXHIBIT "B" - TESTING

SERVICE	TEST REQUIREMENTS
Domestic water	Test hydrostatically at 150 PSI for two (2) hours or at 1.5 times the working pressure when working pressure exceeds 100 PSI
Sanitary, sanitary vent, storm	Maintain 10 ft. head of water for two (2) hours.
Indirect waste	Maintain 10 ft. head of water for two (2) hours.
Pump discharge	Hydrostatically test at 5 PSI greater than the pump rating for two (2) hours.
Natural gas	Refer to Section 227010 - "Natural Gas Systems".

END OF SECTION

SECTION 221020 - UNDERGROUND PIPING AND ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents

1.2 SUBMITTALS

A. Provide a schedule of pipe materials, fittings and connections.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pipe and fittings new and marked with manufacturer's name, complying with applicable ASTM and ANSI Standards.

2.2 CAST IRON SOIL PIPE AND FITTINGS

A. Pipe: ASTM A74 service weight cast iron, bitumen coated, hub and spigot.

B. Fittings: Service weight cast iron, bitumen coated, hub and spigot, ASTM C564 service weight neoprene gasket of same manufacturer as piping.

C. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.3 COPPER PIPE AND FITTINGS

A. Pipe: ASTM B88, Type K, Soft Temper

B. Fittings: ANSI B16.22 wrought copper; ANSI B16.26 and ASTM B62 cast bronze; flared end connections.

2.4 DUCTILE IRON PIPE AND FITTINGS

A. Pipe: AWWA C151/ANSI A21.51, Class 52, ductile iron, mechanical type joints for short runs, otherwise use push-on type joints.

B. Fittings: AWWA C110/ANSI A21.51, ductile iron, 250-psi pressure rating (or) AWWA C153/ANSI A21.53 ductile iron compact fitting, 350 psi pressure rating. Joints shall be restrained, mechanical type for short runs, otherwise use push-on type.

C. Lining: Pipe and fittings shall have double thickness cement mortar lining with seal per AWWA C104/ANSI A21.4 on interior and asphaltic coating on outside.

D. Glands and Gaskets: AWWA C111/ANSI A21.11, ductile iron gland, rubber gasket joints, provide two bronze wedges for each joint of pipe.

2.5 PVC SOLID WALL PIPE AND FITTINGS - DWV SYSTEM

A. Pipe: PVC Schedule 40 solid wall pipe, iron pipe size conforming to ASTM D1785 and ASTM D2665. Pipe shall be manufactured from PVC compounds as identified in ASTM D1784. Both pipe and fittings shall conform to National Sanitation Foundation Standard 14.

B. Fittings: Type DWV, socket type conforming to ASTM D2665. Fittings shall be manufactured from PVC compounds as identified in ASTM D1784. Solvent cement joints shall be made utilizing a two-step process with primer manufactured for thermoplastic piping and solvent cement conforming to ASTM D2564.

2.6 POLYETHYLENE PIPE AND FITTINGS - NATURAL GAS

A. Pipe: ASTM D2513, SDR 11, Fittings: Same material as pipe. Heat fusion joints, socket-type ASTM D2683.

B. Acceptable Manufacturers: Adrisco, Chevron Phillips, or approved equal.

2.7 HIGH-DENSITY POLYETHYLENE (HDPE) SEWER PIPE AND FITTINGS

A. Pipe: Smooth interior and corrugated exterior wall HDPE pipe conforming to AASHTO M252 Type C (3 in. through 10 in.) or AASHTO M 294 Type C (12 in. through 24 in.). Pipe shall be manufactured from HDPE compounds as identified in ASTM D3350 with cell classification of 424420C (3 in. through I 0 in.) and 435400C (12 in. through 24 in.).

B. Fittings: Fittings shall conform to AASHTO M252 or AASHTO M294. Fittings shall be manufactured from compounds as identified in ASTM F810.

C. Joints: Pipe connections shall be made with coupling bands covering at least two full corrugations on each end of pipe meeting soil-tight requirements of AASHTO M252 and M294. Gasketed connections shall incorporate closed-cell synthetic expanded rubber gaskets meeting ASTM D1056 Grade 2A2.

2.8 DETECTABLE TAPE

A. Detectable underground warning tape, 5 mil. polyethylene, 6 in. wide, aluminum backing, APWA approved background colors within permanent black lettering identifying service below.

B. Schedule:

1. Sanitary: Green color, "Caution Buried Sewer Line Below".

2. Storm: Green color, "Caution Buried Sewer Line Below".

3. Water: Blue color, "Caution Buried Water Line Below".

4. Gas: Yellow color, "Caution Buried Gas Line Below".

5. Electric: Red color, "Caution Buried Electric Line Below".

C. Acceptable Manufacturers: Seton, Terra Tape, Pro-Line Safety Products, Inc.

2.9 SCHEDULE OF PIPING MATERIALS

A. See Exhibit "A", Schedule of Piping Materials at end of this section for piping.

PART 3 - EXECUTION

3.1 TESTING

A. Sanitary and Storm:

1. Do not backfill over piping until required tests are completed and the Owner's Representative accepts the system.

2. There shall be no loss of water when testing interior piping inside the building foundation.

3. Air test not acceptable as final test.

4. Should any leaks, defective joints or defective construction be detected in sewers, floors or walls of appurtenant structures, they shall be permanently stopped. Should any defective pipes, fitting or accessories be discovered they shall be removed and replaced at the Contractor's expense.

5. Test exterior piping outside the building foundation in 100 ft. sections. The allowable rate of leakage per 24 hours per in. of diameter per 1,000 ft. of sewer tested shall not exceed 25 gallons. Piping shall be inspected and tested prior to backfill.

6. Confirm in writing that tests have been conducted and successfully completed. Submit copy of the test reports to Owner's Representative.

B. Domestic Water:

1. Do not backfill over piping until required tests are completed and the Owner's Representative accepts the system.

2. Make leaks tight; no caulking permitted. Replace defective fittings, pipe or connections. Piping shall be tight and show no loss of pressure.

3. Air test not acceptable as final test.

4. Confirm in writing that tests and flushing have been conducted and successfully completed. Submit copy of the test report to Owner's Representative.

C. Test exterior water and fire service piping outside the building foundation hydrostatically at 200 psi for two (2) hours. The amount of leakage shall not exceed two (2) quarts per hour per 100 gaskets or joints. Conform to NFPA 24.

3.2 HIGH-DENSITY POLYETHYLENE (HDPE) SEWER PIPE AND FITTINGS

A. Pipe installation shall comply with ASTM D2321 and the manufacturer's recommendations.

3.3 DETECTABLE TAPE

A. Provide detectable tape directly over the buried pipe lines at a depth of 1 ft. - 0 in. below finished grade. Install tape over the continuous length of the pipe.

3.4 GAS PIPING

A. Refer to Section 227010, "Natural Gas Systems".

EXHIBIT "A" - PIPING MATERIALS (PLUMBING)
(Notes are at end of Exhibit "A")

SERVICE	PIPE MATERIALS	FITTINGS	CONNECTIONS
Water and Fire service	Ductile iron water main with cement lining	Ductile iron	Mechanical or push-on type
Water service (2 in. and smaller service)	Type K copper	Cast bronze	Flared
Sanitary and grease waste	Service weight cast iron soil pipe	Cast iron, hub and spigot	Neoprene gasket compression type
	Schedule 40 PVC, solid wall	PVC, socket type	Solvent cement (SEE NOTE 2)
	Schedule 40 PVC, foam core	PVC, socket type	Solvent cement (SEE NOTE 2)
Sanitary and grease waste vent	Service weight cast iron soil pipe	Cast iron, hub and spigot	Neoprene gasket compression type
Storm	Service weight cast iron soil pipe	Cast iron, hub and spigot	Neoprene gasket compression type
	Schedule 40 PVC, solid wall	PVC, socket type	Solvent cement
Natural gas	Schedule 40 steel, factory applied corrosion protective coating	Butt welded steel	Welded (SEE NOTE 1)
	SDR 11 Polyethylene	Polyethylene	Heat fusion

NOTES FOR EXHIBIT A:

NOTE 1: On buried coated steel pipe, tape all joints with Scotchwrap #50, 2 in. wide, 50% overlap. Provide cathodic protection system.

NOTE 2: Schedule 40 PVC pipe may not be used when the temperature of the waste can exceed 140°F.

EXHIBIT "B" - TESTING

SERVICE	TEST REQUIREMENTS
Water service	Test hydrostatically at 150 PSI for two (2) hours or at 1.5 times the working pressure when working pressure exceeds 100 PSI.
Sanitary, sanitary vent, storm	Maintain 10 ft. head of water for two (2) hours.
Acid waste and vent	Maintain 10 ft. head of water for two (2) hours.
Natural gas	Refer to Section 227010 - "Natural Gas Systems".
LG gas (propane)	Refer to Section 227011 - "LP Gas System".
Fire service	Test hydrostatically at 200 PSI or 50 PSI in excess of the system working pressure, whichever is greater for two (2) hours.

END OF SECTION

SECTION 221030 - PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 QUALITY ASSURANCE

A. Follow all requirements, recommendations and appendices to comply with the following publications, codes, standards and listings/approvals:

1. All items here-in used to convey water for potable use shall be lead free in accordance with NSF 61, Standard 61, Section 9 - Standard for Drinking Water and Lavatory Faucets and NSF Standard 372 - Maximum Lead Requirements. Compliance shall be via third party testing and certification.

1.3 SUBMITTALS

A. Submit manufacturer's data in accordance with the Basic Mechanical and Electrical Requirements. Obtain approval prior to ordering material.

B. Provide submittals for all items specified under Part 2 of this Section.

PART 2 - PRODUCTS

2.1 HOT WATER CIRCULATING PUMP

A. Pump: Inline centrifugal, all stainless steel, system fluid lubricated, 145 psi working pressure, 230°F water temperature, ceramic shaft and radial rings, flange mount.

B. Motor: Impedance protected, stainless steel can and static o-ring seals to isolate stator from system fluid, non-overloading throughout the pump curve.

C. Electric Control: Time clock and aquastat for each pump and wiring to motor starter. Starter and time clock by Electrical Contractor.

D. Refer to schedule on drawings for capacity and electrical characteristics.

E. Acceptable Manufacturers: Armstrong, Bell and Gossett, Grundfos.

2.2 SUMP PUMP - SUBMERSIBLE

A. Pump: Simplex, submersible type, 2 in. discharge, bronze construction, non-clog impeller, stainless steel shaft, capable of handling 5/8 in. solids, mechanical seal, minimum 50 gpm capacity.

B. Motor: Oil filled, permanent lubrication, automatic reset thermal overload, oil and water resistant power cord with plug, non-overloading throughout the pump curve.

C. Electric Control: Built-in automatic diaphragm-type pressure switch, completely prewired, requiring only receptacle for plug in power connection.

D. Basin: Basin and cover shall be provided by the General Contractor.

E. Refer to schedule on drawings for capacity and electrical characteristics.

F. Acceptable Manufacturers: Hydromatic, Goulds, Weil, Zoeller.

2.3 SUMP PUMP - SUBMERSIBLE

A. General: Provide pump and control system capable of pumping water and automatically shutting down the pumping system upon the detection of oil in the sump.

B. Pump: Simplex, submersible effluent type, 2 in. discharge, stainless steel construction, capable of handling 5/8 in. solids, mechanical seal, meets UL 778 standard, minimum 50 gpm capacity.

C. Motor: Capable of operating continuously or intermittently, housing constructed of #304 stainless steel, oil filled, permanent lubrication, automatic reset thermal overload, oil and water resistant power cord with plug, non-overloading throughout the pump curve.

D. Basin: Basin and cover shall be provided by the General Contractor.

E. The system shall function automatically and provide audible and visual alarms in the event of the presence of oil in the sump, high liquid in the sump, high amps or a locked rotor condition. LED lights shall be provided to indicate power on and pump running.

F. Electric Control Panel: The control panel shall meet UL 508 standards and be housed in a gasketed NEMA 4X enclosure. The control shall be equipped with a twist lock receptacle, dual solid state relays with variable sensitivity settings, an over current relay, self-cleaning stainless steel sensor probe, high decibel warning horn with alarm silencing switch, dual floats, terminal board, remote monitoring contact, NEMA 4X junction box with twist-lock electrical receptacle and mating conductor cables. Provide all cables between the pump and junction box and the cable and plug from the control unit. The control panel, junction box, pump, floats and sensor shall be factory assembled and tested by a nationally recognized testing laboratory. The system shall allow for the main control panel to be located outside of the elevator shaft and be monitored for all functions. The system shall function automatically and provide audible and visual alarms in the event of the presence of oil in the sump, high liquid in the sump, high amps or a locked rotor condition. LED Lights shall be provided to indicate power on and pump running.

G. Refer to Schedule on Drawings for capacity and electrical characteristics.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pumps shall be installed, aligned and started in accordance with manufacturers written installation instruction.

B. Install pumps in locations to provide access for maintenance and replacement of parts.

C. Support pumps and piping separately so that piping does not support pumps.

D. Provide the services of a factory trained mechanic to start up the system based on factory recommendations. Provide Owner instruction at time of startup. Submit three (3) copies of startup report to the Owner's Representative.

E. All wiring for sump pump(s) between control panel and junction box shall be continuous. No junction boxes allowed within pump basin.

3.2 HOT WATER CIRCULATING PUMP

A. Install shutoff valve and strainer on pump suction; check valve, balancing valve and shutoff valve in pump discharge. Install pressure gauge on suction and discharge piping. Adjust gpm of each circulating pump to capacity as noted.

3.3 SUMP PUMP

A. Install gate valve and check valve in discharge piping for each pump.

B. Simplex pump operation shall be completely automatic. Pressure style switch shall start and stop the pump at the factory set levels. Float style switches shall be adjusted to start and stop the pump at the specified levels.

C. Install liquid level control devices at proper elevation to produce specified sump drawdown. Secure control devices to discharge piping with corrosion resistant brackets and fasteners.

D. Install high water alarm and make electrical connections. Install liquid level control device at proper liquid depth. Secure control device to discharge piping with corrosion resistant brackets and fasteners.

3.4 TESTING

A. Test hot water recirculating pumps for operation.

B. Test sanitary and storm pumping systems for operation at specified liquid depths.

C. Test high water alarm for operation at specified liquid depth.

D. Test domestic water pressure booster pump system for operation.

E. Certify in writing that tests have been performed and the systems are properly operating. Submit three (3) copies of all test reports to the Owner's Representative.

END OF SECTION

SECTION 223010 - EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Document.

1.2 SUBMITTALS

A. Provide submittals for all items specified under Part 2 of this section.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

A. Drain Description: All Floor Drains Type A unless otherwise noted.

1. Type A: Cast iron body, flashing collar with weepholes, nickel bronze, 7 in. diameter adjustable strainer; Jay R. Smith Figure #2010-A.

2. Type B: Cast iron body, flashing collar with weepholes, nickel bronze 7 in. diameter adjustable strainer with separate oval funnel; Jay R. Smith Figure #2010-A with #3590 funnel Type C: Cast iron body, flashing collar with weepholes, 8 in. diameter cast iron grate medium duty, removable sediment bucket; Jay R. Smith Figure #2110.

B. Where floor drains are not installed in slabs on grade, provide flashing collar and flash with 24 in. square four (4) pound lead flashing or equal.

C. Make: Josam, Jay R. Smith, Wade, Watts or Zurn.

2.2 FLOOR SINKS

A. Sink Description:

1. Type A: Acid resistant coated body with 12-1/2 in. square nickel bronze top, 8 in. deep with sediment bucket; Jay R. Smith Figure #3150.

B. Make: Josam, Jay R. Smith, Wade, Watts or Zurn.

2.3 CLEANOUTS

A. Floors: Cast iron body, nickel-bronze top with adjustable feature, bronze plug and flashing clamp where required, carpet marker and tile cover where applicable; Jay R. Smith Series #4028.

B. Walls: Cast iron ferrule, with bronze plug and stainless steel smooth access cover.

1. Horizontal: Jay R. Smith Figure #4402.

2. Vertical: Jay R. Smith Figure #4531.

C. Yard Cleanout:

1. Cast iron body, adjustable round heavy duty top, with tractor cover, vandal proof screws and bronze plug; Jay R. Smith Figure #4246.

D. Make: Josam, Jay R. Smith, Wade, Watts or Zurn.

2.4 GREASE INTERCEPTOR STEEL

A. Welded 1/4 in. steel body, 3/8 in. nonskid tread plate cover, secured with stainless steel bolts, extra heavy leakproof gasket, recessed installation, integral extension to floor/grade. Acid-resistant coating inside and outside.

B. 15 gpm full flow, 10 gallon liquid holding capacity, 3 in. tapped inlet and outlet with outlet vent connection, 30 lb. greasy sludge capacity, removable separator screen, filter screen and anchor flange.

C. Make: Zurn Z1170 - 400, MiFab, or equal.

2.5 LINT INTERCEPTOR

A. Epoxy coated, fabricated steel, coated with primary and secondary stainless steel screens, 3/16 in. plate cover, secured and gasketed, 3 in. inlet and outlet; non-skid-heavy-duty cover.

B. Acceptable Manufacturer: Watts #LI-807 70 gpm flow rate with anchor flange and membrane clamp, extension up to flush with floor, flow control fitting, and sediment bucket.

2.6 WALL HYDRANTS

A. Exposed type hose connection, lead-free, solder connection, nickel bronze face, quarter turn valve, nonfreeze type, 3/4 in. hose connection, self draining, integral vacuum breaker with vandal resistant cap, loose key control and wall clamp; Jay R. Smith Figure #5609QT.

B. Make: Jay R. Smith, Prier, Watts, Woodford or Zurn.

2.7 ROOF HYDRANT

A. Non-freeze, post-type roof hydrant with ASSE 1052 dual check backflow preventer, underdeck clamp support, 1 in. water inlet, 3/4 in. hose connection and 1/8 inch drain port: Wood #RYH2-MS.

B. Make: Jay R. Smith, Watts, Woodford or Zurn.

2.8 SHOCK ABSORBERS

A. Hydropneumatically controlled with permanently sealed expansion chamber pre-charged with non-combustible gas; lead-free, threaded connection, meets or exceeds Plumbing and Drainage Institute Standard PDI WH-201 and ASSE Standard 1010.

1. Bellows Type: Stainless steel construction with stainless steel bellows.

2. Piston Type: Hard drawn copper body with brass piston, cap and adapter, and elastomer seals.

B. Elastomer or rubber compound type bellows not allowed.

C. Make: Watts #LF15M2, Precision Plumbing Products, Jay R. Smith, or Zurn.

2.9 TRAP GUARDS

A. Elastomeric, normally closed seal to prevent evaporation of P-traps. Inserts into throat of floor drain. Provide for each new floor drain.

B. Make: ProVent Systems, Inc. "ProSet Trap Guard".

2.10 WATER PRESSURE GAUGES

A. Construction to be Bourdon tube type; 4-1/2 in. diameter, minimum dial face, stamped stainless steel, replaceable glass lens, with snap-on rings. Phosphor bronze tube, bronze bushed rotary movement, silver brazed or soldered to brass socket and brass tip, 1/4 in. bottom connection. Accuracy, on (1.0) percent of included scale range. White dial face with black numerals, graduated in pounds; equipped with bronze pulsation dampener or snubber and needle valve.

B. Make: Trerice, Weiss, Weksler, Winters.

2.11 PIPING SYSTEM THERMOMETERS

A. Industrial type, plastic, aluminum or steel case, glass or plastic front, non-toxic organic liquid filled, red reading column, white or silver V-shaped scale, black numerals. Union flange mounted, separable socket with thermowell, extension necks were required; range as called for service. Universal adjustable type, 9 in. scale. For installation in water systems where the maximum temperature is less than 120°F, graduations of 1°F, accurate to within 1/2°F. For installation greater than 120°F, graduations of 2°F, accurate to

B. Make: Trerice, Weiss, Weksler, Winters.

2.12 TEMPERATURE MIXING VALVE - ELECTRONIC TYPE

A. Valve shall mix 140°F hot water with 40°F cold water to obtain a water outlet temperature of 120°F. The valve shall consist of the following:

1. Electronic style, single thermostatic mixing valve with 3/4 in. inlet and 3/4 in. outlet. Flow capacity of 27 gpm at 7.5 psi pressure drop, and 43 gpm at 20 psi pressure drop.

2. 3 wire floating fail in place 24v actuator, capable of 14 to 130 degrees F, with an accuracy of +/-3°F.

3. LCD user interface/controller with battery backup.

4. Provide valves on hot, cold and tempered water piping with fittings, nipples, trim piping and escutcheon plates. Horizontal stem dial thermometers on hot, cold and tempered water piping.

5. DZR low lead brass lead free mixing valve and trim exposed on wall.

B. Make: Caleffi Legiomix 6000 series.

2.13 LAUNDRY UTILITY BOX (WMB)

A. Guy Gray, Model DLWB1 washing machine supply and drain fitting with hot and cold water 1/2 in. sweat shutoff valves, 2 in. drain connection and in 20 gauge, white powder coated steel cabinet with faceplate.

B. Provide vacuum breakers on each hose connection.

PART 3 - EXECUTION

3.1 EQUIPMENT CONNECTIONS

A. Plumbing Contractor shall:

1. Provide all roughing and final water, waste, vent, gas, air, vacuum, diesel and/or oxygen connections to all equipment requiring same as called for on Contract Documents.

2. Refer to Contract Documents for roughing schedules, and equipment and lists indicating scope of connections required.

3. Provide loose key stops, "P" traps, tailpieces, adapters, gas or air cocks and all necessary piping and fittings from roughing point to equipment.

4. Provide for installation of sinks, faucets, traps, tailpieces provided by an Equipment Contractor. These items to be delivered, in easily identified cartons, to the proper room for Contractor's installation.

5. Install controls and devices furnished by others.

6. Provide cold water line with gate valve and backflow prevention device at locations called for. Continuation and connection to equipment by others.

7. Install relief valve discharge piping from equipment relief valves.

8. Provide for Owner furnished equipment:

   a. Connect complete and ready for use, including all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, etc., as required by Owner.

   b. Refer to manufacturer Drawings and Specifications for requirements of special equipment. Verify connection requirements before bidding.

3.2 CLEANOUTS

A. Install cleanouts out of traffic patterns and flush to floor. Provide offset from sanitary line served. Do not locate under doors or under lockers. Maintain distance between cleanouts on piping 4 in. and smaller, 50 ft.; over 4 in., 100 ft. At changes in direction greater than 45°. Install at base of soil, waste, vent, stacks and roof conductors and where called for.

B. Cleanouts: Same nominal size as pipe, but not larger than 4 in.

3.3 WALL HYDRANTS

A. Install minimum 24 in. above grade.

3.4 HOSE BIBBS

A. Install at low points of piping system.

3.5 SHOCK ABSORBERS

A. Install in vertical position.

3.6 THERMOMETERS

A. Provide on piping system where called for and shown, with thermometer well at each location, mounted in oversize tee or elbow to provide as little restriction as possible to fluid flow, stems or proper length to allow accurate reading. Arrange to be easily read from floor.

B. Select range such that the maximum system working temperature is in the middle one-third of the scale.

3.7 PRESSURE GAUGES

A. Provide in piping system where called for and shown, with needle valve and pulsation damper or snubber at each location. Arrange to be easily read from the floor.

B. Select range such that the maximum system working temperature is in the middle one-third of the scale.

3.8 TEMPERATURE MIXING VALVE

A. Provide where called for. Provide 2 ft. - 0 in. deep heat trap on hot water supply line ahead of connection to mixing valve.

B. Provide factory-trained technician to start up, adjust and inspect the mixing valve and piping for correct installation and temperature adjustment.

3.9 GREASE TRAP

A. Install in accordance with manufacturer's written installation instructions.

B. Provide concrete hold down pad as indicated on drawing.

C. Set trap on a 6 in. deep level bed of compacted pea gravel spread evenly over the top of the concrete pad.

D. Secure trap to pad with anchor bolts hooked under reinforcing rods of the hold down pad. Coat bolts, rods and other exposed metal surfaces with three coats of black asphaltum.

END OF SECTION

SECTION 223400 - WATER HEATERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Work of this section shall be performed in accordance with the requirements of the Contract Documents, including but not limited to Instructions to Bidders, Agreement and General Conditions, General Requirements and Basic Mechanical/Electrical Requirements.

B. Provide labor, materials, equipment and services to perform work and related work required by Contract Documents for a complete operating system.

1.2 SUBMITTALS

A. Submit manufacturer's data for approval in accordance with Basic Mechanical/Electrical Requirements. Obtain approval prior to ordering material.

B. Provide submittals for all products to be installed including, but not limited to:

1. Water Heater.
2. Tank Protective Valves.
3. Expansion Tank.
4. All Heater and Tank Accessories.
5. All System Wiring Diagrams.
6. Tank Lining.
7. Condensate Neutralizer Kit.

1.3 SPECIAL COORDINATION

A. Coordinate all work of other trades in Water Room.

B. Furnish Division 26 "Electric" with dimensional drawings showing location of electrical connections, location of equipment mounted on walls, and of other equipment requiring electrical connections, removals or replacements.

PART 2 - PRODUCTS

2.1 WATER HEATER SEMI-INSTANTANEOUS, GAS-FIRED CONDENSING TYPE

A. Provide gas-fired, condensing fire tube heater with a modulating power burner.

B. Units to fire on Natural gas.

C. Heater shall be UL/FM approved with an input of 250 mbh and an output of 225 mbh with a minimum efficiency of 96%.

D. Heater shall have a recovery rate of 291 GPH at 100°F rise.

E. The tank shall be lined with Vitraglas® vitreous enamel and shall have a bolted hand hole cleanout.

F. The tank shall have four extruded magnesium anode rods installed in separate head couplings.

G. This water heater shall be equipped with stainless steel cold water inlet, Hydrojet® Sediment Reduction System.

H. This water heater shall be equipped with an electronic ignition system, an ASME rated T&P relief valve and a premix closed combustion system for direct venting using either 2", 3", 4" or 6" PVC, CPVC, Polypropylene, Stainless Steel, or ABS vent pipe.

I. The water heater shall be factory assembled and tested. The water heater shall be approved for zero inch clearance to combustibles.

J. A digital LCD display shall be integrated into the front and be an adjustable electronic thermostat to any temperature up to 180°F. A recycling Energy Cut Off (E.C.O.) shuts off all gas in the event of an overheat condition.

K. The entire installation shall be made in compliance with state and local codes and ordinances.

L. Basis-of-Design: Bradford White Model EF-100T-250E-3N or approved equal.

2.2 THERMAL EXPANSION TANK

A. Vertical steel expansion tank constructed and designed per ASME Code Section VIII, 150 PSI working pressure, steel outer shell, rigid polypropylene liner, heavy duty butyl rubber diaphragm and non-ferrous system connection tapping, suitable for potable hot water, factory pre-charged at 15 PSI. Tank will have a 12 in. diameter and a height of 18 in. with a 6.4 gallon total volume and 0.80 maximum acceptance factors. The manufacturer will be similar to Model ST-12C by Amtrol, Wessel or approved equal.

B. Design Equipment: Watts.

C. Acceptable Manufacturers: Amtrol, Watts, Wessel or approved equal.

2.3 TANK PROTECTIVE VALVES

A. Pressure Relief Valves:

1. ASME stamped and rated.

2. Open at 125 lbs. pressure sized for full heating capacity.

3. Make: Bell & Gossett, Kunkle, Watts or approved equal.

B. Temperature and Pressure Relief Valve:

1. ASME stamped and rated (for steam or hot water).

2. Size for full heat input.

3. Complying with Federal Spec. MIL-V-13612C.

4. Valve shall be sized and selected by manufacturer for tank and heater installed.

5. Make: Camco, Cash-Acme, Watts, or approved equal.

PART 3 - EXECUTION

3.1 WATER HEATERS

A. Install each heater on a 6 in. high concrete pad.

B. Pipe pressure and temperature relief valve drain to discharge to nearest floor drain.

C. Provide all electric wiring and equipment in accordance with manufacturer's wiring diagrams and instructions. Make all final connections.

D. Provide all piping, valves and fittings in accordance with manufacturer's piping instructions. Make all final connections.

E. Provide equipment in accordance with contract drawings and all local codes.

F. Provide gas pressure regulator when inlet gas pressure exceeds 14 in. w.c.

G. Provide start-up services of a factory trained technician to inspect the installation based on factory recommendations. Items include but are not limited to:

1. Verification of proper piping arrangement.

2. Fuel supply piping and connection(s).

3. Combustion efficiency.

4. Verification of proper temperature rise across heater(s).

5. Verification of proper venting with draft reading.

6. Operating and safety controls.

7. Proper operation of equipment.

8. Verification of piping arrangement and aquastat location.

9. Verification of proper gas pressure to unit and to burners.

10. Relief valve settings and AGA BTU capacities.

11. All control settings.

H. Submit three (3) copies of startup reports in writing with all factory checkout data signed by the factory authorized service agent to the Owner's Representative.

I. Place equipment in operation.

J. The installation of water heaters shall be based on the details shown on the drawings and specified in this Section. Approved water heaters provided other than type shown or specified shall be installed in accordance with manufacturer's recommended installation instructions and piping diagrams.

3.2 INSTANTANEOUS WATER HEATERS

A. Install instantaneous type water heaters as recommended by the manufacturer. Place and secure anchorage devices to building structure. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible.

3.3 STORAGE TANKS AND HEATERS

A. Provide 2 in. drain with valve off bottom.

B. Install tank on a 6 in. high concrete pad.

C. Temperature and Pressure Relief Valves:

1. Extend drain piping to terminate at 6 in. above floor or floor drain. Support all discharge piping independent of valves to eliminate strain on valve bodies.

2. Install all valves per ANSI Z21.22.

3. The temperature sensing elements shall be immersed in the water within the top 6 in. of the top of the tank.

4. Install pressure relief valve in the cold water line.

D. Unused Tank Openings:

1. Provide solid brass or bronze plugs in all unused tank openings.

3.4 CONDENSATE NEUTRALIZERS

A. Verify if condensate neutralizer is available from factory to be provided with water heater to site.

B. Install unit with 1/2 in. polyethylene tubing or piping in accordance with the water heater manufacturer's recommendations.

END OF SECTION

SECTION 224000 - PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUBMITTALS

A. Submit manufacturer's data in accordance with Basic Mechanical/Electrical Requirements. Obtain approval prior to ordering material.

B. Provide submittals for all items specified under Part 2 - Products of this section.

1.3 DESCRIPTION OF FIXTURES

A. Fixtures and trim shall be of those manufacturers listed, unless otherwise indicated. Fixtures for this project shall be of same manufacturer.

1. Fixtures: American Standard, Kohler, Mansfield, Sloan, Toto, Watts or Zurn.

2. Faucets: Chicago Faucets, Delta, Moen, Symmons, T&S Brass or Zurn. All faucets shall be lead-free in accordance with NSF 61 and NSF 372.

3. Closet Seats: Bemis, Beneke, Church or Olsonite.

4. Fixture Carriers: Jay R. Smith, Watts, Wade, Josam or Zurn.

5. Sinks: Elkay, Just or Kohler.

6. Water Coolers: Elkay, Halsey Taylor or Haws.

7. Supplies, Stops and Traps: Brasscraft, EBC, McGuire or Sanitary Dash.

B. Exposed parts of trim shall have polished chrome plated finish.

C. Tubular drainage products ("P" traps, nipples, etc.) shall be 17 gauge brass.

1.4 QUALITY ASSURANCE

A. Comply with requirements of the Plumbing Fixture Law of the New York State Department of Environmental Conservation.

B. Comply with the American Disabilities Act Guidelines and ANSI A117.1 "Accessible and Usable Buildings and Facilities".

C. All items here-in used to convey water for potable use shall be lead free in accordance with NSF Standard 61, Section 9 Standard for Drinking Water and Lavatory Faucets and

NSF Standard 372 - Maximum Lead Requirements. Compliance shall be via third-party testing and certification.

D. All fixture trim used to convey water for potable use shall be lead free.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

A. WC-A (HDCP):

1. American Standard #2386.012 Cadet 3 Right Height, floor mounted, vitreous china, siphon action jetted, tank type, elongated bowl, close coupled, 16-1/2 in. high rim, fully glazed 2 in. ball pass trapway, 1.28 GPF fitted with the following:

   a. Church #380TC extra heavy weight, white elongated solid plastic, open front seat with cover.

   b. McGuire #166 chrome plated angle supply with 3/8 in. x 12 in. flexible riser, wheel handle stop and wall escutcheon with set screw.

   c. Cast iron closet flange with stainless steel bolts and wax setting ring.

   d. Color matching bolt caps.

2.2 LAVATORIES

A. LAV-A (HDCP):

1. American Standard #0355.012 Lucerne, 20 in. x 18 in., wall hung, vitreous china lavatory with 4 in. centers, front overflow, self-draining deck and punching for concealed arm carrier, fitted with following:

   a. F-C faucet as specified herein.

   b. McGuire #155WC offset chrome plated P.O. plug with open grid strainer and 1-1/4 in., 17 gauge offset tailpiece.

   c. McGuire #8902 chrome plated, 17 gauge, 1-1/4 in. x 1-1/2 in. "P" trap with cleanout plug and cast brass escutcheon with set screw.

   d. McGuire # LF165LKF, lead-free, 3/8 in. chrome plated wall supplies with loose key angle stops, 12 in. long flexible risers, cast brass escutcheon with set screws.

   e. Jay R. Smith Series 700 concealed arm floor mounted carrier with rectangular uprights.

   f. Cover exposed waste, stops and supply piping with ADA conforming pipe covers, Truebro, Inc. "Lav-Guard".

g. Mount at ADA required height and location or as shown on Architectural drawings.

B. LAV-B:

1. American Standard #0497.221, 21-1/2 in. x 17 in. oval, undermount, vitreous china lavatory with front overflow fitted with the following:

a. F-L faucet as specified herein.

b. McGuire #155-A chrome plated PO plug with open grid strainer and 1-1/4 in., 17 gauge tailpiece.

c. McGuire #8902 chrome plated, 17 gauge, 1-1/4 in. x 1-1/2 in. "P" trap with cleanout plug and cast brass escutcheon with set screw.

d. McGuire # LF165LKF, lead-free, 3/8 in. chrome plated wall supplies with loose key angle stops. 12 in. long flexible risers, and cast brass escutcheon with set screws.

2.3 SINKS

A. SK-A (HDCP):

1. Elkay Lustertone LRAD2219, 22 in. x 19 in. x 6 in. deep, nickel type 302 stainless steel single bowl sink, ADA compliant, three (3) faucet holes, 18 gauge, self rimming for countertop installation, fitted with the following:

a. F-O faucet as specified herein.

b. Elkay #LKAD18 stamped brass drain outlet with 3 in. perforated grid strainer and LKADOS 1-1/2 in. O.D. offset tailpiece.

c. McGuire #8912 semi-cast brass adjustable "P" trap, 1-1/2 in. x 1-1/2 in., with cleanout plug and cast brass escutcheon with set screw.

d. McGuire #LF2167LKF, lead-free, 1/2 in. copper sweat supplies with 1/2 in. OD flexible risers, loose key stops and cast brass escutcheons with set screws.

2.4 FAUCETS

A. F-C:

1. Chicago Faucets Hytronic #116.221.AB.1, dual supply, with user adjustable temperature mixing valve and integral checks, CP solid cast brass electronic sensor faucet, battery operated, deck mounted, 4 in. centers, lead-free, cover plate, vandalproof non-aerating spray outlet, stainless steel braided hose supply, ADA compliant and fitted with the following:

a. 0.50 GPM aerator.

b. Chicago #131-ABNF, lead-free, thermostatic mixing valve, 3/8 in. connections

c. 6 volt lithium CRP2 battery.

d. ADA compliant, chrome plated.

B. F-L: Chicago Faucets #420-POABCP lift-on/push off single lever lead-free faucet with pop-up waste, 4 in. centers, 4-5/8 in. spout, 1.5 laminar flow outlet, ceramic volume and temperature control cartridge, ADA compliant.

1. Chicago #131-ABNF, lead-free, thermostatic mixing valve, 3/8 in. connections.

C. F-O:

1. Chicago #431ABCP, single lever washerless sink faucet, integral 9-1/2 in. cast brass swing spout, temperature limiter , deck mounted, 8 in. centers, lead-free, ADA compliant and fitted with the following:

a. 1.5 GPM aerator.

b. Chicago #131-ABNF, lead-free thermostatic mixing valve, 3/8 in. connections.

c. #369 standard lever handles.

d. ADA compliant.

2.5 MOP BASINS

A. MB-A:

1. Fiat Model MSB, molded stone, 24 in. x 24 in. x 10 in. deep, stainless steel flat strainer, 2 in. outlet with the following:

a. T&S Brass #B-0665-BSTP, lead-free, exposed wall mounted faucet with integral stops, rough chrome finish, lever handles, top brace spout with bucket hook, hose end and vacuum breaker.

b. Fiat # 832AA Hose and Hose Bracket.

c. Fiat #889CC Mop Hanger.

d. Fiat # E77AA Vinyl Bumper guard on exposed sides.

e. Fiat #MSG 2424 Stainless Steel Wall Guard.

f. Provide silicone sealant between wall, floor and mop basin.

PART 3 - EXECUTION

3.1 FIXTURES, EQUIPMENT AND SYSTEMS

A. Install fixtures, equipment and systems as shown on Drawings or specified herein in accordance with provisions of each applicable Specification Section and all local and state codes having jurisdiction.

3.2 INSTALLATION OF PLUMBING FIXTURES

A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers written installation instructions.

B. Carefully drill holes for through bolts to avoid chipping blocks or plaster.

C. Except where carriers are specified, attach hangers or brackets to walls as follows:

1. Masonry Construction: Secure fixture hangers to partition by thru-bolts extending through a steel plate on opposite side of partition. Obtain Owner's Representative's approval prior to work.

2. Metal Stud Construction: Anchor backing for fixtures or equipment to 1/8 in. x 12 in. steel plate bolted or riveted to at least three studs. Obtain Owner's Representative's approval prior to work.

D. Anchor carriers to concrete floor with 1/2 in. x 3 in. anchor or thru-bolts and washers. Provide for drilling of floor and installation of expansion shields. Quantity of anchors:

1. Water Closets - Four (4).

2. Lavatories - Eight (8).

3. Urinals - Eight (8).

E. Seal fixtures in contact with walls, floors and counters using a sanitary-type, one-part, mildew-resistant, silicone caulk. Match color to fixture color.

F. Set self-rimming lavatories and sinks in a bed of silicone caulk.

G. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.

H. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.

I. Install wall-hanging, back-outlet urinals with gasket seals.

J. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified and to building wall construction where no support is indicated.

K. Fasten counter-mounting-type plumbing fixtures to casework.

L. Metering faucets shall be adjusted for minimum ten (10) second run time, but not more than 0.25 gallons per cycle.

M. Immediately after installation, provide protective covering over fixtures and trim.

3.3 MOUNTING HEIGHT AND LOCATION

A. Mount fixtures at height and location as indicated on Architectural plans and elevations.

B. Mount accessible fixtures in conformance with the requirements of ANSI A117.1.

3.4 CONNECTIONS

A. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22.

3.5 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings and controls.

B. Adjust water pressure at electric water coolers, faucets and flush valves to provide proper flow and stream.

C. Replace washers of leaking and dripping faucets and stops.

D. Clean fixtures, fittings, spout and drain strainers with manufacturers' recommended cleaning methods and materials.

E. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components and retest. Repeat procedure until all units operate properly.

END OF SECTION

SECTION 224000.10 - SUPPLEMENTAL TO FIXTURE SCHEDULE

PART 1 - GENERAL

1.1 BATHTUBS

A. Type A: (cast iron)

1. American Standard #2265.379.

a. As required. 5 ft. - 0 in. long x 30 in. wide x 14 in. high, white enameled cast iron, recessed bathtub with slip resistant bottom and the following trim.

b. Concealed pop-up waste with overflow, level handle, brass elbows, tee and 1-1/2 in., 17 gauge brass tubing.

2. Accessories:

a. Mixing Valve: Equal to Powers Hydroguard Type #410 pressure balancing valve with check stops, level handle, color insert, stainless steel trim and adjustable temperature limit stop.

1) Make: Powers: #802, Symmons, or approved equal.

b. Tub Spout.

1.2 SHOWERS

A. All showers Type "A" unless otherwise noted.

B. Type "A":

1. AKER Model NF6034 60 in. x 34 in. x 74 in. one piece shower cabinet (verify sizes with Architect), white acrylic with fiberglass and polyester resin backing, 2 in., chrome plated cast brass drain and arranged for right or left hand valves as indicated on drawings and fitted with the following:

a. Textured one piece floor integral threshold and recessed soap dish.

b. Provide 1 in. diameter stainless steel curtain rod with 10 oz. white shower curtain with curtain hooks.

c. Power #413 Hydroguard mixing valve pressure type with check stops maximum temperature stop and lever handle and escutcheon plate.

d. Powers #141-376 deluxe self-cleaning shower head all brass construction, ball joint, spray adjustment, 2.5 gpm flow control, #141-198 heavy duty arm and die cast flange with locking set screw.

1.3 WASHING MACHINE BOX (WMB)

A. Guy Gray, Model DLWB1 space saver washing machine supply and drain fitting.

1. Provide fire rated box where required.

END OF SECTION

SECTION 227010 - NATURAL GAS SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUBMITTALS

A. Provide manufacturer's data sheets and installation instructions for all equipment and accessories in this section in accordance with Basic Mechanical/Electrical Requirements and Division 01.

1.3 QUALITY ASSURANCE

A. Follow all requirements, recommendations, and appendices to comply with the following publications, codes, standards, and listings:

1. 2020 Fuel Gas Code of New York State.

2. American Gas Association.

3. Local Utility Company.

B. Provide equipment and accessories that are listed and labeled by a nationally recognized testing laboratory.

1.4 GAS SERVICE

A. All new underground gas service piping from the street main to, and including, the gas meter will be installed by Orange & Rockland Utilities

B. The cost of this work shall be included in this Contractor's bid.

1.5 GAS PRESSURE

A. The maximum allowable gas pressure inside the building is 1/2 psi.

PART 2 - PRODUCTS

2.1 GAS PIPING

A. Piping Materials: Refer to Specification Section 221010, "Piping Systems and Accessories".

B. All exposed exterior and interior piping shall be primed and painted with one coat of alkyd primer and two coats of exterior acrylic latex gloss enamel. Color shall be as selected.

2.2 VALVES

A. Refer to Specification Section 220523, "Valves".

2.3 GAS PRESSURE REGULATORS

A. By Plumbing Contractor.Cast iron body, die-cast aluminum alloy diaphragm case, field adjustable, removable orifice, internal relief valve, threaded connections, lockup style. Provide if Utility Company service pressure is more than 11" W.C.

B. Inlet pressure 14 in. wc, outlet pressure 11 in. wc, 0 to 6812 CFH.

C. Design Equipment: Sensus.

2.4 Manufacturers: Sensus, Fisher Controls or approved equal.FLEXIBLE CONNECTORS

A. Stainless steel construction and in accordance with ANSI Z21.24.

2.5 LOCATOR TAPE

A. Yellow plastic tape, intended for direct-burial service, not less than 6 in. wide x 4 mils thick with #10 AWG coated stranded copper wire tracer. Lettering on the tape shall state, "CAUTION: BURIED GAS LINE BELOW".

B. Manufacturers: Calpico, Griffolyn, Terra Tape or approved equivalent.

PART 3 - EXECUTION

3.1 ARRANGEMENTS

A. Make arrangements with Orange & Rockland Utilities to provide the gas service and meter at the indicated location.

B. Contact the utility company for the cost of the service, its fees and required permits. Pay all costs and include within the base bid.

C. The service load is 6,812,000 Btuh. The pressure at the meter outlet shall be set at 11 in. wc.

D. Coordinate all service requirements with the utility company.

E. The contractor shall arrange for the plumbing inspector to inspect the gas piping and vent installations upon completion including underground and rough-ins, as well as installation of gas-fired appliances.

3.2 GAS DISTRIBUTION SYSTEM

A. Provide distribution system from gas meter outlet, including meter pad, fence enclosure, mains, risers, branches, drips, shut-offs and other required parts. Connect to equipment or appliances indicated or specified as requiring gas for their operation.

B. Provide shutoff valve at the meter outlet. Provide all parts and accessories needed to connect to meter.

C. Furnish sleeve and sealing element for above ground gas piping entry through outside wall. Make entry gas and watertight.

3.3 PIPING INSTALLATION

A. Install gas piping at a uniform slope of 1/4 in. in 15 ft. to prevent traps. Horizontal lines shall slope upward to risers to the equipment.

B. Drips and Sediment Traps: Install drips at points where condensate may collect. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.

C. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down. Connect branch piping from top or side of horizontal piping.

D. Install unions in pipes 2 in. and smaller, adjacent to each valve, regulator and at final connection to each piece of equipment. Unions are not required on flanged devices.

E. Provide pressure regulator in supply to each gas fired appliance as required.

F. Install valve and strainer on the supply side of each gas pressure regulator.

G. 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.

H. Install containment conduits for buried gas piping within building in gas-tight conduits extending 12 in. minimum 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.

I. Install pressure-relief or pressure-limiting devices so they can be readily operated to determine if valve is free; test to determine pressure at which they will operate; and examine for leakage when in closed position.

3.4 WELDING

A. Welding shall be performed in compliance with the welding procedure specifications prepared by the National Certified Pipe Welding Bureau. Welded pipe fabricated by certified welder. Contractor shall submit proof of current certification of each welder if requested by the Owner. Use full-length pipe where possible; minimum distance between welds, 18 in. on straight runs. Welds must be at least full thickness of pipe with inside smooth; remove cutting beads, slag and excess material at joints; chamfer ends. Minimum gap 1/8 in., maximum 1/4 in. for butt welds. Overlaps on position and bench welds to be not less than 3/4 in. One internal pass and one external pass minimum required on slip-on flanges. Do not apply heat to rectify distorted pipe due to concentrated welding; replace distorted pipe. Exercise caution to prevent heat related damage to plastic parts within the gas meter or regulators.

B. Welder qualifications: Welded piping fabricated by certified welder. Welder shall be certified under ASME or API Code III.

3.5 CONNECTIONS

A. Install gas piping next to gas-utilizing equipment and appliances for servicing and maintenance. Connect gas piping to gas-utilizing equipment and appliances with shutoff valves and unions. Make connections to equipment downstream of valves and unions with flexible connectors. Valves, unions and flexible connectors shall be same size as the gas supply piping to the equipment.

B. Install a gas valve upstream within 6 ft. of each gas-utilizing appliance. Install a union connection downstream from the valve to permit removal of controls.

C. Sediment Traps: Install full size tee fittings forming drips, as close as practical to gas appliance inlets. Cap or plug bottom outlet.

3.6 UNDERGROUND PIPING INSTALLATION

A. All underground piping shall be installed by a utility approved contractor in accordance with the gas company's requirements.

B. Qualification by the utility company is required for the individual making heat-fusion joints.

C. The service main shall be installed with a minimum 36 in. cover and shall in all cases conform to be requirements of the pipe manufacturer instructions.

D. Install piping a minimum 5 ft. - 0 in. from buildings.

3.7 LOCATOR TAPE

A. Install the locator tape with the gas main, which can be used to help determine the location of the gas piping at a future time. Locate directly over the buried gas line at a depth of 6 in. below finished grade.

B. Terminate tracer wire in cast iron boxes. Maximum spacing between boxes shall be 500 ft.

3.8 GAS PIPING TESTS

A. Test natural gas systems according to 2020 Fuel Gas Code of New York State and the local utility requirements unless otherwise noted:

1. Test pressure shall be 1-1/2 times working pressure, but not less than 3 psi for two (2) hours for steel piping.

2. Pressure testing of plastic piping shall be per utility's requirements.

B. Tests shall be witnessed by utility company. Make arrangements, provide all necessary items to complete testing and pay all costs.

C. All tests shall be performed prior to the connection of equipment. Regulator shall be isolated from test pressures. Soap test shall be conducted on all joints. Repair leaks and defects with new materials. Retest system until satisfactory results are obtained.

D. Verify correct pressure settings for pressure regulators.

E. Provide written certification that tests have been conducted and satisfactorily completed. Submit to Owner's Representative.

3.9 GAS LINE PURGING

A. At completion of pressure test, purge all natural gas systems according to 2020 Fuel Gas Code of New York State and the utility company requirements.

B. Provide three (3) days notice to utility company to have the meter unlocked for service and equipment start up. Make all arrangements and pay all fees as required by the Utility Company.

END OF SECTION

SECTION 230500 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, tools, materials, accessories, parts, transportation, taxes, and related items, essential for installation of the work and necessary to make work, complete, and operational. Provide new equipment and material unless otherwise called for. References to codes, specifications and standards called for in the specification sections and on the drawings mean, the latest edition, amendment and revision of such referenced standard in effect on the date of these contract documents. All materials and equipment shall be installed in accordance with the manufacturer's recommendations.

1.2 LICENSING

A. The Contractor shall hold a license to perform the work as issued by the authority having jurisdiction.

B. Plumbing contract work shall be performed by, or under, the direct supervision of a licensed master plumber.

C. Electrical contract work shall be performed by, or under, the direct supervision of a licensed electrician.

1.3 PERMITS

A. Apply for and obtain all required permits and inspections, pay all fees and charges including all service charges. Provide certificate of approval from the Authorities Having Jurisdiction prior to request for final payment.

B. Provide electrical inspection certificate of approval from Middle Department Inspection Agency, Commonwealth Inspection Agency, or an Engineer approved Inspection Agency prior to request for final payment.

1.4 CODE COMPLIANCE

A. Provide work in compliance with the following:

1. 2020 Building Code of New York State.
2. 2020 Fire Code of New York State.
3. 2020 Plumbing Code of New York State.
4. 2020 Mechanical Code of New York State.
5. 2020 Fuel Gas Code of New York State.
6. 2020 Property Maintenance Code of New York State.
7. 2020 Energy Conservation Code of New York State

8. Accessible and Usable Buildings and Facilities, ICC A117.1 (2009).

9. New York State Department of Labor Rules and Regulations.

10. New York State Department of Health.

11. 2017 National Electrical Code (NEC).

12. Occupational Safety and Health Administration (OSHA).

13. Local Codes and Ordinances.

14. Life Safety Code, NFPA 101.

1.5 GLOSSARY

ACI	American Concrete Institute
AGA	American Gas Association
AGCA	Associated General Contractors of America, Inc.
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AFBMA	Anti-Friction Bearing Manufacturer's Association
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing Materials
AWSC	American Welding Society Code
AWWA	American Water Works Association
FM	Factory Mutual Insurance Company
IBR	Institute of Boiler & Radiation Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association

NYS/DEC	New York State Department of Environmental Conservation
SBI	Steel Boiler Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UFPO	Underground Facilities Protective Organization
UL	Underwriter's Laboratories, Inc.
OSHA	Occupational Safety and Health Administration
XL - GAP	XL Global Asset Protection Services

1.6 DEFINITIONS

Acceptance	Owner acceptance of the project from Contractor upon certification by Owner's Representative.
As Specified	Materials, equipment including the execution specified/shown in the contract documents.
Basis of Design	Equipment, materials, installation, etc. on which the design is based. (Refer to the article, Equipment Arrangements, and the article, Substitutions.)
Code Requirements	Minimum requirements.
Concealed	Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.
Coordination Drawings	Show the relationship and integration of different construction elements and trades that require careful coordination during fabrication or installation, to fit in the space provided or to function as intended.
Delegated-Design Services	Performance and Design criteria for Contractor provided professional services. Where professional design services or certifications by a design professional are specifically required of a Contractor, by the Contract Documents. Provide products and systems with the specific design criteria indicated. If criteria indicated is insufficient to perform services or certification required, submit a written request for additional information to the Engineer. Submit wet signed and sealed certification by the licensed design professional for each product and system specifically assigned to the Contractor to be designed or certified by a design professional. Examples: structural maintenance ladders, stairs and platforms, pipe anchors, seismic compliant system, wind, structural supports for material equipment, sprinkler hydraulic calculations.
Equal, Equivalent, Equal To, Equivalent To, As Directed and As Required	Shall all be interpreted and should be taken to mean "to the satisfaction of the Engineer".
Exposed	Work not identified as concealed.
Extract	Carefully dismantle and store where directed by Owner's Representative

	and/or reinstall as indicated on drawings or as described in specifications.
Furnish	Purchase and deliver to job site, location as directed by the Owner's Representative.
Inspection	Visual observations by Owner's site Representative.
Install	Store at job site if required, proper placement within building construction including miscellaneous items needed to affect placement as required and protect during construction. Take responsibility to mount, connect, start-up and make fully functional.
Labeled	Refers to classification by a standards agency.
Manufacturers	Refer to the article, Equipment Arrangements, and the article, Substitutions.
Prime Professional	Architect or Engineer having a contract directly with the Owner for professional services.
Product Data	Illustrations, standard schedules, performance charts, instructions, brochures, wiring diagrams, finishes, or other information furnished by the Contractor to illustrate materials or equipment for some portion of the work.
Provide (Furnish and Install)	Contractor shall furnish all labor, materials, equipment and supplies necessary to install and place in operating condition, unless otherwise specifically stated.
Relocate	Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use.
Remove	Dismantle and take away from premises without added cost to Owner, and dispose of in a legal manner.
Review and Reviewed	Should be taken to mean to be followed by "for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents".
Roughing	Pipe, duct, conduit, equipment layout and installation.
Samples	Physical full scale examples which illustrate materials, finishes, coatings, equipment or workmanship, and establishes standards by which work will be judged.
Satisfactory	As specified in contract documents.
Shop Drawings	Fabrication drawings, diagrams, schedules and other instruments, specifically prepared for the work by the Contractor or a Sub-contractor, manufacturer, supplier or distributor to illustrate some portion of the work.
Site Representative	Owner's Inspector or "Clerk of Works" at the work site.
Submittals Defined (Technical)	Any item required to be delivered to the Engineer for review as requirement of the Contract Documents. The purpose of technical submittals is to demonstrate for those portions of the work for which a submittal is required, the manner in which the Contractor proposes to conform to the information given and design concepts expressed and required by the Contract Documents.

1.7 SHOP DRAWINGS/PRODUCT DATA/SAMPLES

A. Provide submittals on all items of equipment and materials to be furnished and installed. Submittals shall be accompanied by a transmittal letter, stating name of project and contractor, name of vendor supplying equipment, number of drawings, titles, specification sections (name and number) and other pertinent data called for in individual sections. Submittals shall have individual cover sheets that shall be dated and contain: Name of project; name of prime professional; name of prime contractor; description or names of equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Individual piecemeal or incomplete submittals will not be accepted. Similar items, (all types specified) shall be submitted at under one cover sheet per specification section (e.g. valves, plumbing fixtures, etc.). Number each submittal by trade. Indicate deviations from contract requirements on Letter of Transmittal. Submittals will be given a general review only. Corrections or comments made on the Submittals during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. If submitting hard copies, submit four (4) copies for review.

B. If submittals are to be submitted electronically, all requirements in Item A apply. Submittals shall be emailed in PDF format to specific email address provided by the Construction Manager, General Contractor, Architect or Project Manager. Name of project shall be in subject line of email. Send emails to mealbasubmittalclerk@meengineering.com.

C. Refer to Division 01 for additional requirements.

1.8 PROTECTION OF PERSONS AND PROPERTY

A. Contractor shall assume responsibility for construction safety at all times and provide, as part of contract, all trench or building shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, and other safety feature required to provide safe conditions for all workmen and site visitors.

1.9 EQUIPMENT ARRANGEMENTS

A. The contract documents are prepared using one manufacturer as the Basis of Design, even though other manufacturers' names are listed. If Contractor elects to use one of the listed manufacturers other than Basis of Design, submit detailed drawings, indicating proposed installation of equipment. Show maintenance clearances, service removal space required, and other pertinent revisions to the design arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger motors, feeders, breakers, and equipment, additional control devices, valves, fittings and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of roughing and connections by other trades. Remove and replace doorframes, access doors, walls, ceilings, or floors required to install other than Basis of

Design. If revised arrangement submittal is rejected, revise and resubmit specified Basis of Design item which conforms to Contract Documents.

1.10 SUBSTITUTIONS

A. If Contractor desires to bid on any other kind, type, brand, or manufacture of material or equipment than those named in specifications, secure prior approval. To request such approval, Contractor shall submit complete information comparing (item-for-item) material or equipment offered with design material or equipment. Include sufficient information to permit quick and thorough comparison, and include performance curves on same basis, capacities, power requirements, controls, materials, metal gauges, finishes, dimensions, weights, etc., of major parts. If accepted, an addendum will be issued to this effect ahead of bid date. Unless such addendum is issued, substitution offered may not be used.

1.11 UTILITY COMPANY SERVICES

A. Division 26 shall make arrangements with National Grid for electric service to the Owner's distribution equipment. Provide underground or overhead electric service as called for and transformers, meter sockets or meter compartments as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the electric service shall comply with the published Utility Company standards

B. Division 22 shall make arrangements with National Grid for gas service to the Owner's distribution system. Provide service to the building as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the gas service shall comply with the published Utility Company standards

1.12 ROUGHING

A. The Contract Drawings have been prepared in order to convey design intent and are diagrammatic only. Drawings shall not be interpreted to be fully coordinated for construction.

B. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Make necessary changes in contract work, equipment locations, etc., as part of a contract to accommodate work to avoid obstacles and interferences encountered. Before installing, verify exact location and elevations at work site. DO NOT SCALE plans. If field conditions, details, changes in equipment or shop drawing information require an important rearrangement, report same to Owner's Representative for review. Obtain written approval for all major changes before installing.

C. Install work so that items both existing and new are operable and serviceable. Eliminate interference with removal of coils, motors, filters, belt guards and/or operation of doors. Provide easy, safe, and code mandated clearances at controllers, motor starters, valve access, and other equipment requiring maintenance and operation. Provide new materials, including new piping and insulation for relocated work.

D. Coordinate work with other trades and determine exact route or location of each duct, pipe, conduit, etc., before fabrication and installation. Coordinate with Architectural Drawings. Obtain from Owner's Representative exact location of all equipment in finished areas, such as thermostat, fixture, and switch mounting heights, and equipment mounting heights. Coordinate all work with the architectural reflected ceiling plans and/or existing Architecture. Mechanical and electrical drawings show design arrangement only for diffusers, grilles, registers, air terminals, lighting fixtures, sprinklers, speakers, and other items. Do not rough-in contract work without reflected ceiling location plans.

E. Before roughing for equipment furnished by Owner or in other Divisions, obtain from Owner and other Divisions, approved roughing drawings giving exact location for each piece of equipment. Do not "rough in" services without final layout drawings approved for construction. Cooperate with other trades to insure proper location and size of connections to insure proper functioning of all systems and equipment. For equipment and connections provided in this contract, prepare roughing drawing as follows:

1. Existing Equipment: Measure the existing equipment and prepare for installation in new location.

2. New Equipment: Obtain equipment roughing drawings and dimensions, then prepare roughing-in-drawings. If such information is not available in time, obtain an acknowledgement in writing, then make space arrangements as required with Owner's Representative.

1.13 COORDINATION DRAWINGS

A. Before construction work commences, Divisions for all trades shall submit coordination drawings in the form of CAD drawing files, drawn at not less than 1/4 in. scale. Such drawings will be required throughout all areas, for all Contracts. These drawings shall show resolutions of trade conflicts in congested areas. Mechanical Equipment Rooms shall be drawn early in coordination drawing process simultaneous with all other congested areas. Prepare Coordination Drawings as follows:

1. Division 23 shall prepare the base plan CAD coordination drawings showing all ductwork, all pertinent heating piping, and equipment. These drawings may be CAD files of the required Ductwork Shop Drawings. The drawings shall be coordinated with lighting fixtures, sprinklers, air diffusers, other ceiling mounted items, ceiling heights, structural work, maintenance clearances, electric code clearance, reflected ceiling plans, and other contract requirements. Reposition proposed locations of work after coordination drawing review by the Owner's Representative. Provide adjustments to exact size, location, and offsets of ducts, pipes, conduit, etc., to achieve reasonable appearance objectives. Provide these adjustments as part of contract. Minor revisions need not be redrawn.

2. Division 23shall provide CAD files and submit the base plan CAD Coordination Drawings to all Divisions.

3. Divisions 21 and 22 shall draw the location of piping and equipment on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolutions.

4. Divisions 26, 27 and 28 shall draw the location of lighting fixtures, cable trays, and feeders over 1-1/2 in. on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolution.

5. The General Construction Trade shall indicate areas of architectural/structural conflicts or obstacles on the CAD Coordination Drawings, and coordinate to suit the overall construction schedule.

6. The General Construction Trade shall expedite all Coordination Drawing work and coordinate to suit the overall construction schedule. In the case of unresolved interferences, he shall notify the Owner's Representative. The Owner's Representative will then direct the various trades as to how to revise their drawings as required to eliminate installation interferences.

7. If a given trade proceeds prior to resolving conflicts, then if necessary, that trade shall change its work at no extra cost in order to permit others to proceed with a coordinated installation. Coordination approval will be given by areas after special site meetings involving all Divisions.

B. The purpose of the coordination drawing process is to identify and resolve potential conflicts between trades, and between trades and existing or new building construction, before they occur in construction. Coordination drawings are intended for the respective trade's use during construction and shall not replace any Shop Drawings, or record drawings required elsewhere in these contract documents.

1.14 EQUIPMENT AND MATERIAL REQUIREMENTS

A. Provide materials that meet the following minimum requirements:

1. Materials shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less, in accordance with NFPA 255.

2. All equipment and material for which there is a listing service shall bear a UL label.

3. Potable water systems and equipment shall be built according to AWWA Standards.

4. Gas-fired equipment and system shall meet AGA Regulations and shall have AGA label.

5. Fire protection equipment shall be UL listed and FM approved.

B. Exterior and wet locations shall utilize materials, equipment supports, mounting, etc. suitable for the intended locations. Metals shall be stainless steel, galvanized or with baked enamel finish as a minimum. Finishes and coatings shall be continuous and any surface damaged or cut ends shall be field corrected in accordance with the manufacturer's recommendations. Hardware (screws, bolts, nuts, washers, supports, fasteners, etc.) shall be:

1. Stainless steel where the associated system or equipment material is stainless steel or aluminum.

2. Hot dipped galvanized or stainless steel where the associated system or equipment is steel, galvanized steel or other.

1.15 CUTTING AND PATCHING

A. Each trade shall include their required cutting and patching work unless shown as part of the General Construction Contract. Refer to General Conditions of the Contract for Construction, for additional requirements. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch cut or abandoned holes left by removals of equipment or fixtures. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

1.16 PAINTING

A. Paint all insulated and bare piping, pipe hangers and supports exposed to view in mechanical equipment rooms, penthouse, boiler rooms and similar spaces. Paint all bare piping, ductwork and supports exposed to the out-of-doors with rust inhibiting coatings. Paint all equipment that is not factory finish painted (i.e. expansion tanks, etc.).

B. All painting shall consist of one (1) prime coat and two (2) finish coats of non-lead oil base paint, unless otherwise indicated herein. Provide galvanized iron primer for all galvanized surfaces. All surfaces must be thoroughly cleaned before painting. Review system color coding prior to painting with the Owner's Representative or Architect.

C. All items installed after finished painting is completed and any damaged factory finish paint on equipment furnished under this contract must be touched up by the Contractor responsible for same.

D. Include painting for patchwork with color to match adjacent surfaces. Where color cannot be adequately matched, paint entire surface. Provide one (1) coat of primer and two (2) finish coats or as called for in the Specifications.

E. All primers and paint used in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

F. Refer to Division 9 - Finishes, for additional information.

1.17 CONCEALMENT

A. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

1.18 CHASES

A. New Construction:

1. Certain chases, recesses, openings, shafts, and wall pockets will be provided as part of General Construction Trade. Mechanical and Electrical trades shall provide all other openings required for their contract work.

2. Check Architectural and Structural Design and Shop Drawings to verify correct size and location for all openings, recesses and chases in general building construction work.

3. Assume responsibility for correct and final location and size of such openings.

4. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.

5. Provide 18 gauge galvanized sleeves and inserts. Extend all sleeves 2 in. above finished floor. Set sleeves and inserts in place ahead of new construction, securely fastened during concrete pouring. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Firestop all unused sleeves.

6. Provide angle iron frame where openings are required for contract work, unless provided by General Construction trade.

1.19 PENETRATION FIRESTOPPING

A. Fire-Stopping for Openings Through Fire and Smoke Rated Wall and Floor Assemblies:

1. Provide materials and products listed or classified by an approved independent testing laboratory for "Penetration Fire-Stop Systems". The system shall meet the requirements of "Fire Tests of Penetrations Fire-Stops" designated ASTM E814.

2. Provide fire-stop system seals at all locations where piping, tubing, conduit, electrical busways/cables/wires, ductwork and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities which permit the easy removal or addition of electrical conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion, and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating.

5. Plastic pipe/conduit materials shall be installed utilizing intumescent collars.

6. Provide a submittal including products intended for use, manufacturer's installation instructions, and the UL details for all applicable types of wall and floor penetrations.

7. Fire-stopping products shall not be used for sealing of penetrations of non-rated walls or floors.

B. Acceptable Manufacturers:

1. Dow Corning Fire-Stop System Foams and Sealants.

2. Nelson Electric Fire-Stop System Putty, CLK and WRP.

3. S-100 FS500/600, Thomas & Betts.

4. Carborundum Fyre Putty.

5. 3-M Fire Products.

6. Hilti Corporation.

1.20 NON-RATED WALL PENETRATIONS

A. Each trade shall be responsible for sealing wall penetrations related to their installed work, including but not limited to ductwork, piping, conduits, etc. See individual specification sections for requirements.

1.21 SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, and other items to properly support contract work. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above.

B. For precast panels/planks and metal decks, support mechanical/electrical work as determined by manufacturer and the Engineer. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

C. For finished areas without a finished ceiling system such as classrooms, offices, conference rooms, etc., where decking and structure is exposed, and ductwork/piping/conduit is exposed: All mounting brackets, channel support systems and mounting hardware for ductwork, piping, lighting, etc. shall be concealed and approved by the Architect/Engineer prior to the installation. AirCraft cable style hanging for ductwork is required. It is recommended that room mockups be done and receive Architect/Engineer approval prior to proceeding with installation.

D. Equipment, piping, conduit, raceway, etc. supports shall be installed to minimize the generation and transmission of vibration.

E. Materials and equipment shall be solely supported by the building structure and connected framing. Gypboard, ceilings, other finishes, etc. shall not be used for support of materials and equipment.

1.22 ACCESS PANELS

A. Provide access panels for required access to respective trade's work. Location and size shall be the responsibility of each trade. Access panels provided for equipment shall provide an opening not smaller than 22 in. by 22 in. Panels shall be capable of opening a minimum of 90 degrees. Bear cost of construction changes necessary due to improper information or failure to provide proper information in ample time. Access panels over 324 square inches shall have two cam locks. Provide proper frame and door type for various wall or ceiling finishes. Access panels shall be equal to "Milcor" as manufactured by Inland Steel Products Co., Milwaukee, Wisconsin. Provide General Construction trade with a set of architectural plans with size and locations of access panels.

1.23 CONCRETE BASES

A. Provide concrete bases for all floor mounted equipment. Provide 3,000 lb. concrete, chamfer edges, trowel finish, and securely bond to floor by roughening slab and coating with cement grout. Bases 4 in. high (unless otherwise indicated); shape and size to accommodate equipment. Provide anchor bolts in equipment bases for all equipment provided for the project, whether mounted on new concrete bases or existing concrete bases.

1.24 HVAC EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide final connections to all equipment as required by the equipment. Provide final connections, including domestic water piping, wiring, controls, and devices from equipment to outlets left by other trades. Provide equipment waste, drip, overflow and drain connections extended to floor drains.

C. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, as required.

1.25 PLUMBING EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide roughing and final connections to all equipment. Provide loose key stops, sanitary "P" traps, tailpiece, adapters, gas or air cocks, and all necessary piping and fittings from roughing point to equipment. Provide installation of sinks, faucets, traps, tailpiece furnished by others. Provide cold water line with gate valve and backflow prevention device at locations called for. Provide continuation of piping and connection to equipment that is furnished by others. Provide relief valve discharge piping from equipment relief valves.

C. Provide valved water outlet adjacent to equipment requiring same. Provide equipment type floor drains, or drain hubs, adjacent to equipment.

D. Install controls and devices furnished by others.

E. Refer to Contract Documents for roughing schedules, and equipment and lists indicating scope of connections required.

F. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, as required.

1.26 ELECTRICAL EQUIPMENT CONNECTIONS

A. Provide complete power connections to all electrical equipment. Provide control connections to equipment. Heavy duty NEC rated disconnect ahead of each piece of equipment. Ground all equipment in accordance with NEC.

B. Provide for Owner furnished and Contractor furnished equipment all power wiring, electric equipment, control wiring, switches, lights, receptacles, and connections as required.

1.27 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

A. Store Materials on dry base, at least 6 in. aboveground or floor. Store so as not to interfere with other work or obstruct access to buildings or facilities. Provide waterproof/windproof covering. Remove and provide special storage for items subject to moisture damage. Protect against theft or damage from any cause. Replace items stolen or damaged, at no cost to Owner.

B. Refer to Division 01 for additional information.

1.28 FREEZING AND WATER DAMAGE

A. Take all necessary precautions with equipment, systems and building to prevent damage due to freezing and/or water damage. Repair or replace, at no change in contract, any such damage to equipment, systems, and building. Perform first seasons winterizing in presence of Owner's operating staff.

1.29 OWNER INSTRUCTIONS

A. Before final acceptance of the work, furnish necessary skilled labor to operate all systems by seasons. Instruct designated person on proper operation, and care of

systems/equipment. Repeat instructions, if necessary. Obtain written acknowledgement from person instructed prior to final payment. Contractor is fully responsible for system until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing. List under clear plastic, operating, maintenance, and starting precautions procedures to be followed by Owner for operating systems and equipment.

1.30 OPERATION AND MAINTENANCE MANUALS

A. Submit by email (preferred) or digital media, thru the normal project submittal process. Include a copy of each final approved Shop Drawing, wiring diagrams, piping diagrams, spare parts lists, final testing and balancing report, as-built drawings and manufacturer's instructions. Include typewritten instructions, describing equipment, starting/operating procedures, emergency operating instructions, summer-winter changeover, freeze protection, precautions and recommended maintenance procedures. Include name, address, and telephone number of installing contractor and of supplier manufacturer Representative and service agency for all major equipment items. Provide a table of contents page and dividers based upon specification section numbers. Submit in a compiled and bookmarked PDF format as outlined below.

B. Provide content for Operation and Maintenance Manuals as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer and Commissioning Agent will comment on whether content of operation and maintenance submittals is acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

C. Submit Operation and Maintenance Manuals in the following format:

1. Submit by uploading to web-based project software site, or by email to Architect, as a formal project submittal in conformance with the project specific submittal procedures. Enable reviewer comments on draft submittals.

2. 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.

3. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in the 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.

D. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing Owner training. Engineer and Commissioning Agent will comment on whether general scope and content of manual are acceptable.

E. Final Manual Submittal: Submit O&M manual in final form prior to requesting inspection for Substantial Completion and at least 2 weeks before commencing Owner training. Engineer and Commissioning Agent will return copy with review comments.

1. Correct or revise O&M manual to comply with Engineer's and Commissioning Agent's comments. Submit copies of each corrected manual within 2 weeks of receipt of Engineer's and Commissioning Agent's comments.

F. Refer to Division 01 for additional requirements.

1.31 RECORD DRAWINGS

A. The Contractor shall obtain at his expense one (1) set of construction Contract Drawings, (including non-reproduction black and white prints or electronic files) for the purpose of recording as-built conditions.

B. The Contractor shall perform all survey work required for the location and construction of the work and to record information necessary for completion of the record drawings. Record drawings shall show the actual location of the constructed facilities in the same manner as was shown on the bid drawings. All elevations and dimensions shown on the drawings shall be verified or corrected so as to provide a complete and accurate record of the facilities as constructed.

C. It shall be the responsibility of the Contractor to mark EACH sheet of the contract documents in red and to record thereon in a legible manner, any and all approved field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other changes shall also be maintained. At completion of the work, the complete set of red marked contract documents, plus all approved field sketches and diagrams shall be submitted to the engineer and used in preparation of the record drawings.

D. A complete set of red marked contract drawings shall be submitted, at one time, as the "Record" set. If there are no changes to a specific drawing, the contractor shall indicate "NO CHANGES" on that drawing. ALL drawings shall be included in the "Record" set.

E. The complete set of red marked Contract Documents or electronic files shall be certified by the Contractor as reflecting record conditions and submitted to the engineer for review.

F. The Contractor shall have the marked up set scanned, if they are not already electronic files, and then submit them to the Engineer as the "Record Set".

G. Refer to Division 01 for additional requirements.

1.32 FINAL INSPECTION

A. Upon completion of all Engineering Site Observation list items, the Contractor shall provide a copy of the Engineering Site Observation Report back to the Engineer with each items noted as completed or the current status of the item. Upon receipt, the Engineer will schedule a final review.

1.33 COMMISSIONING

A. Refer to General Commissioning Requirements in Division 01 for additional requirements.

1.34 TEMPORARY HEATING AND COOLING

A. Refer to the General Conditions of the Contract for Construction and Supplemental General Conditions.

1.35 MAINTENANCE OF HVAC SYSTEMS DURING TEMPORARY USE PERIODS

A. Provide each air handling system with a set of prefilters in addition to the permanent filters. Furnish four sets of prefilters for each system for use when system is operated for temporary heating or cooling. During such use, change prefilters as often as directed by Owner's Representative. Provide MERV-8 filters in all open ended ducts, return grilles and registers to keep dust out of ductwork. Change as often as necessary. Remove all such temporary filters upon completion. Use supply fans only. Do not operate return fans.

B. Blank-off outside air intake opening during temporary heating period. Install first set of permanent filters and prefilters.

C. Adjust dampers on supply system.

D. Set all heating coil control valves for manual operation.

E. Do not install any grilles or diffusers at room terminal ends of ducts until permission is given.

F. Assume responsibility for systems and equipment at all times, even though used for temporary heat or ventilating. Repair or replace all dented, scratched or damaged parts of systems prior to final acceptance.

G. Remove concrete, rust, paint spots, other blemishes, then clean.

H. Just prior to final acceptance, remove used final filter and install new set. Deliver all unused sets of prefilters to the Owner and obtain written receipt. Properly lubricate system bearings before and during temporary use. Maintain thermostats, freeze stats, overload devices, and all other safety controls in operating condition.

1.36 TEMPORARY FACILITIES

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.37 TEMPORARY LIGHT AND POWER

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.38 CLEANING

A. It is the Contractor's responsibility to keep clean all equipment and fixtures provided under this contract for the duration of the project. Each trade shall keep the premises free from an accumulation of waste material or rubbish caused by his operations. The facilities require an environment of extreme cleanliness, and it is the Contractor's responsibility to adhere to the strict regulations regarding procedures on the existing premises. After all tests are made and installations completed satisfactorily:

1. Thoroughly clean entire installation, both exposed surfaces and interiors.

2. Remove all debris caused by work.

3. Remove tools, surplus, materials, when work is finally accepted.

1.39 SYSTEM START-UP AND TESTING

A. Prior to commencement of work, the Division(s) effecting such system shall survey all building mechanical, plumbing, fire protection and electrical systems and components and make written notice to the Owner's Representative regarding any damage, missing items and/or incomplete systems. Prior to the conclusion of this project, the Contractor shall verify with the Owner's Representative that all building systems have been returned to their original conditions.

1.40 TRANSFER OF ELECTRONIC FILES

A. M/E Engineering, P.C. will provide electronic files for the Contractor's use in the preparation of sheetmetal shop drawings, coordination drawings, or record drawings related to the project, subject to a and the following terms and conditions:

1. The Contractor shall submit a formal request for electronic drawing files on the M/E Engineering, P.C. website, by utilizing the following website link: http://www.meengineering.com/contact-pages/contractor-request.

2. M/E Engineering, P.C. makes no representation as to the compatibility of these files with the Contractor's hardware or the Contractor's software beyond the specific release of the referenced specifications.

3. M/E Engineering, P.C. can only provide CAD files of M/E/P/FP drawing levels for which we are the Engineer of Record. CAD files of Architectural backgrounds, reflected ceiling plans, structural plans, etc. must be obtained separately from the Architect of Record.

4. Data contained on these electronic files is part of M/E Engineering, P.C.'s instruments of service shall not be used by the Contractor or anyone else receiving data through or from the Contractor for any purpose other than as convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by the Contractor or by others will be at the Contractor's sole risk and without liability or legal exposure to M/E Engineering, P.C. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against M/E

Engineering, P.C., its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with the Contractor's use of the electronic files.

5. Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless, M/E Engineering, P.C. from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from the Contractor's use of these electronic files.

6. These electronic files are not contract documents. Significant difference may arise between these electronic files and corresponding hard copy contract documents due to addenda, change orders or other revisions. M/E Engineering, P.C. makes no representation regarding the accuracy or completeness of the electronic files the Contractor receives. In the event that a conflict arises between the signed contract documents prepared by M/E Engineering, P.C. and electronic files, the signed contract documents shall govern. The Contractor is responsible for determining if any conflicts exist. By the Contractor's use of these electronic files the Contractor is not relieved of the Contractor's duty to comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, field verify conditions and coordinate the Contractor's work with that of other contractors for the project.

1.41 ENERGY INCENTIVES

A. The Contractor, his Subcontractors and Suppliers shall provide to the Owner all paperwork necessary to support the Owners pursuit of incentives related to energy conservation as offered by the utility company or state sponsored incentive programs. This shall include at a minimum, receipts, and quantities and data sheets for energy efficient equipment such as: lighting, motors, variable frequency drives, etc.

END OF SECTION

SECTION 230504 - ELECTRIC WIRING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services for the complete installation of motor control wiring and temperature control wiring as required in Contract Documents. Provide wiring and conduit, required to connect devices furnished as part of or adjunctive to the automatic temperature control system and for motor control regardless of the source of supply. Control wiring includes 120 volt and lower voltage wiring for control signals directing equipment operation. Control circuits shall be 120 volt maximum. Provide wiring in accordance with requirements specified in Division 26, "Electrical" and the National Electrical Code. Provide devices required for proper system operation, including special electrical switches, transformers, disconnect switches, relays, and circuit breaker protection.

B. Coordinate all work with Division 26, "Electrical".

1.2 WORK NOT INCLUDED

A. Power wiring for motors, motor starters and associated starting and control equipment, are included in Division 26, "Electrical", unless otherwise called for.

1.3 QUALIFICATIONS

A. Wiring shall be installed in compliance with all requirements of Division 26, "Electrical".

1.4 SUBMITTALS

A. Provide complete wiring diagrams for equipment systems. Deliver wiring diagrams to proper trades in time for roughing of conduit, equipment connections, and avoid delay in construction schedule. Wiring diagrams and roughing information to be wired as part of the Work of Division 26, "Electrical", shall be clearly indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Refer to Division 26 specifications for required wiring materials.

PART 3 - EXECUTION

3.1 GENERAL

A. Check electrical wiring pertaining to equipment for completeness and correctness of connections. Correct any misapplied motor and/or motor starter, improper thermal overload device, or device which fails to function and resultant damage, whether due to incorrect connections or improper information on wiring diagrams.

3.2 WIRING FOR CONTROL SYSTEMS

A. Provide motor control and temperature control wiring for equipment. All wiring shall be in conduit, unless otherwise noted. Refer to Section 260501 for type of conduit to be used in specific applications. Provide 18 in. length flexible conduit at motors and devices subject to vibration. Conduit supported on 5 ft. centers. Do not attach directly to hot surfaces, piping, or ductwork. Control wiring shall be in separate conduit from all other wiring. Provide green grounding wire circuited from starter, and run ground wire through conduit to each remote auxiliary relay, pushbutton station, remote panel heating device, thermostat, or device with potentials in excess of 50 volts. Size ground wire as required by NEC.

B. All temperature control wiring shall be plenum rated type, meeting the requirements of NEC Article 300.

C. Provide pushbutton stations, pilot lights, selector switches, auxiliary starter contacts, and other devices required to provide specified functions.

D. Where allowable by Code and contract documents, temperature control wiring may be installed without conduit. Installation and wire insulation types shall be as described by NEC, Article 725. All low voltage wiring circuits 50 volt and under shall:

1. Be adequately supported using bridle rings spaced a maximum of 3 ft. on centers or other approved method when installed horizontally above accessible ceilings or run exposed in unfinished areas.

2. Be installed in conduit when run in wall cavity or surface metal raceway where no access is available to wall cavity, in finished areas.

3. Be installed in conduit when installed vertically in Mechanical/Utility Rooms from panels and devices up to above ceiling, or 10 ft. above finished floor if no ceiling.

4. Be installed in conduit in all cases not specifically covered by the above cases, or where subject to physical damage.

3.3 EQUIPMENT WIRING

A. Provide power and control wiring between sections of electrical radiation units, between shipping splits, and between remote panels, thermostats, disconnect switches, and their respective units. Provide control wiring from the package control system, to each respective electric heat coil, reheat coil or motor. Properly mount control package. Power wiring to and including disconnect switch shall be by Division 26 "Electrical".

3.4 FIELD WIRING IN STARTERS, CONTROLLERS AND PANELS

A. Wiring within starters, controllers, and temperature control panels, shall be routed neatly in gutter space, away from moving and/or heat producing parts. Provide suitably rated terminal blocks. Do not place more than two wire connections on pilot device or relay terminal. Where more than two circuit connections are required, use terminal blocks.

Provide nylon insulated, ring spade terminal for all control wires. Cables and wires shall be neatly bundled and lashed with nylon cable straps.

END OF SECTION

SECTION 230513 - MOTORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services as required for the complete installation designed in Contract Documents.

1.2 SUBMITTALS

A. Submit manufacturer's product data on all motors.

B. Product Data: For each motor, provide dimensions; mounting arrangements; frame type, enclosure type, location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings and characteristics.

C. Motor Performance Data: For each motor, include the following manufacturers' data:

1. Motor Performance: Percent Efficiency, Power Factor, Torque, RPM, Duty Rating and Design Category.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Motor manufacturer shall be based and headquartered in the United States of America and shall design and manufacture motors in the United States.

2. Motor manufacturer shall have over fifteen (15) years-experience in the motor industry and shall maintain active company-wide quality assurance program.

3. Motor manufacturer shall maintain an authorized service center within 60 miles of the project site, capable of providing training, parts and emergency maintenance and repairs.

B. Motor performance shall be warranted against material and workmanship defects by manufacturer's limited warranty and service policy for the period of at least 18 months from the day of shipment from the factory or the manufacturer's warehouse.

1. Premium efficiency motors shall be warranted for 36 months.

2. Severe duty motors (as applicable) shall be warranted for 60 months.

3. Extended warranty shall be offered for certain products or as agreed by additional terms and specified elsewhere.

PART 2 - PRODUCTS

2.1 MOTORS

A. General Requirements:

1. Motors built for 60 Hz operation, three phase for 1/2 HP and larger; single phase for 1/3 HP and smaller.

   a. In compliance with NEMA Standards, wound specifically for nameplate voltage, and selected for appropriate duty and environment.

   b. 1.15 minimum service factor at rated voltage and frequency. 1.0 service factor for inverter duty motors.

   c. Bearings: Bearings shall have a rated fatigue life of L-10 (B-10) of 150,000 hours for direct-coupled applications and 50,000 hours for belted applications minimum. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG 1-14.43. The calculation will be determined from the pulley centerline being at the end of the motor shaft.

   d. V-belt connected motors with adjustable slide rail bases and pulleys.

   e. Motors shall have Class F insulation system, with Class B temperature rise, insulation meeting NEMA MG 1 Part 31. Maximum allowable motor temperature rise for open drip-proof (ODP) or totally enclosed fan cooled (TEFC) type at 1.15 service factor shall be 105°C above 40°C ambient with a total temperature rating of 155°C.

   f. NEMA locked rotor kVA code as required to match unit equipment torque characteristics.

   g. Single-phase motors shall be capacitor start, induction run, or split phase type.

   h. Polyphase motors shall be constant speed, squirrel cage, unless otherwise specified.

   i. Nameplates shall have as a minimum, all information as described in NEMA Standard MG-1-20.60. Motor nameplate shall be mounted on enclosure with stainless steel fastening pins.

2. Motors for use with adjustable speed drive applications shall be premium efficiency inverter duty rated in accordance with NEMA and be capable of a 20:1 turndown.

   a. These motors shall meet NEMA corona inception voltage requirements, withstanding peak voltages up to 1600 volts, and be manufactured in accordance with NEMA MG 1 Part 30 and 31.

b. All motors controlled by adjustable speed drives shall be equipped with circumferential micro-fiber shaft grounding rings to provide protection from electrical bearing damage, to meet NEMA MG 1, 31.4.4.3. Provide AEGIS Bearing Protection Ring Kit (or equal), installed in accordance with the manufacturer's recommendation. For motors controlled by adjustable speed drives and 50hp or greater the motor shall have a ceramic electrically insulating bearing assembly on the opposite end of the grounding brushes.

3. EC Motors:

a. The motor shall be DC rated with permanent magnet rotor and automatically resetting integral overload protection.

b. The unit shall meet the scheduled voltage, phase, control and other requirements indicated.

c. Input Control: The unit shall have the following control features as a minimum:

1) Packaged Unit controls: DDC input to include start/stop/status/general trouble.

2) External Control: Minimum of Modbus and/or BACnet digital start/stop, digital trouble, 0-10VDC and 4-20mA speed control input.

d. Unit insulation shall be Class H.

e. Electrical termination lugs shall be suitable for the intended feed circuit.

f. Ratings shall be 90% minimum power factor and 10% maximum total harmonic distortion.

g. Speed control suitable for 100% to 10% operational capability.

h. Fully programmable and reviewable settings and parameters.

i. Suitable for operation at ambient conditions of 32 to 104 degrees F.

j. The power circuiting shall be separated from the low voltage control circuiting.

k. Output parameters where indicated:

1) Speed.

2) Trouble indication.

3) Overload indication.

4. Three phase motors rated 1 HP and greater shall be copper winding, re-lubable ball bearings, 1.15 service factor (1.0 service factor for inverter duty motors), premium efficiency, energy-saver type with a guaranteed NEMA nominal full-load efficiency, by IEEE Standard 112 Test Method "B". Efficiency rating shall appear on nameplate, and shall be not less than as follows; per NEMA MG 1 Part 12, Table 12-12, nominal minimum efficiencies:

MINIMUM NOMINAL FULL-LOAD MOTOR EFFICIENCY						
HP	ODP MOTORS (RPM)			TEFC MOTORS (RPM)		
	1200	1800	3600	1200	1800	3600
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

5. Nominal Motor Voltage Table:

Nominal System Voltage	Motor Nameplate
480V - 3 phase	460 volt
240V - 1 phase and 3 phase	230 volt
208V - 1 phase and 3 phase	200 volt
120V - 1 phase	115 volt

6. Motor Application; Provide the following enclosure types unless noted otherwise:

Environment/Location	Motor Enclosure Type
General Purpose	Open drip-proof, TEFC with cast iron frame, or encapsulated
Outdoors, below grade or high humidity	TEFC with cast iron frame
Hazardous	Explosion-proof
Packaged Refrigeration Compressors	Hermetic or semi-hermetic

7. Acceptable Manufacturers: Motors need not all be of the same manufacturer. Subject to the requirements of this section provide products by the following:

   a. General Electric Energy & Saver NEMA Premium Efficiency/(ODP); General Electric X$D Ultra NEMA Premium Efficiency (TEFC).

   b. Century/A.O. Smith Speed Plus

   c. Baldor-Reliance Super E.

   d. Lincoln Ultimate E CTAC.

   e. Marathon XRI.

   f. Siemens GO100A.

   g. Nidec Motor Co. (U.S. Motors) Premium Efficient.

PART 3 - EXECUTION

3.1 MOTORS

A. Furnished by equipment manufacturer and especially manufactured and/or selected, mounted, and installed for intended use. Install motors accessible for maintenance and belt adjustment.

END OF SECTION

SECTION 230516 - VIBRATION ABSORBERS, EXPANSION COMPENSATORS AND EXPANSION JOINTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUBMITTALS

A. Submit product data on items provided for each piece of equipment.

B. Submit detailed fabrication drawings for all field fabricated anchors.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Vibration Isolation for Piping: Section 230548 - Vibration Isolation of Mechanical Systems.

B. Anchors and Guides: Section 232010 - Piping Systems and Accessories.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION FOR PIPING

A. Pipe runs connected to mechanical equipment should be mounted on steel spring and/or elastomer isolators as called for in "Vibration Isolation" Section.

2.2 VIBRATION ABSORBERS

A. Metal Bellows Type: Manufactured of stainless steel convoluted metal bellows with 150# ASA drilled carbon steel flanges. The bellows are to be filled with silicone rubber and the integral gaskets shall be vulcanized to the flanges surface. Absorbers shall be pressure tested at 225 psi and suitable for 300° operating temperature.

B. Design Equipment: Thermo Tech, Inc.

C. Make: Hyspan, Flexhose, Thermo Tech Inc.,

2.3 EXPANSION COMPENSATORS - TWO-PLY BRONZE BELLOWS

A. 3/4 in. through 3 in. installed in copper lines, 1-1/2 in. compression stroke, 1/2 in. extension stroke. 300 psi working pressure at 600°F. Metal enclosure over bellows with anti-torque device, bronze construction, threaded or solder ends.

B. Design Equipment: Keflex Model 7Q or 7QT.

C. Make: Flexonics, Hyspan, Keflex, Metraflex, Flexhose

2.4 EXPANSION COMPENSATORS - TWO-PLY STAINLESS STEEL

A. 3/4 in. through 3 in. installed in steel lines, two-ply stainless steel bellows, 1-1/2 in. compression stroke, 1/2 in. extension stroke. 300 psi working pressure at 600°F. Metal enclosure over bellows with anti-torque device, steel construction, threaded or flanged ends.

B. Design Equipment: Keflex Model 7Q-MPT or 7QFL.

C. Make: Flexonics, Hyspan, Keflex, Metraflex, Flexhose

2.5 RADIATION GUIDES AND ANCHORS

A. For use with expansion compensators (see above) within fin radiation enclosures.

B. Two piece full circumference nylon guide, bolted to "L" bracket. Keflex Model CTG, Tri-State Industries A-Series or equal.

C. Two piece, bolted copper tube anchor and "L" bracket. Keflex Model CTA, Tri-State Industries C-Series or equal.

2.6 EXTERNALLY PRESSURIZED EXPANSION JOINTS

A. Expansion joints shall be of the pack-less type, leak proof, maintenance-free, all welded construction with multi-ply bellows and a full protection shroud capable of withstanding the full design pressure.

B. The system pressure shall be external to the bellows element.

C. The expansion joint shall have internal/external guides to prevent the bellows from being subjected to movement for which it is not designed to accommodate.

D. All expansion joints shall have an integral internal liner.

E. End fittings shall be welded end suitable for mating pipe.

F. The outer liner shall have a drain port.

G. The bellows element shall be corrugated from multi-ply laminated tubes of Type 300 Series stainless steel suitable for the application.

H. The internal liner and external shroud shall be carbon steel pipe of thickness capable of withstanding full design pressure.

I. Design Equipment: Keflex Model EPEJ.

J. Make: Flexonics, Metraflex, Flexhose, Keflex.

2.7 FLEXIBLE EXPANSION LOOPS

A. Provide flexible expansion loops of size and type as shown on the drawings, which will provide a flexible pipe loop that will absorb and compensate multi-plane movements simultaneously as well as reduce piping stress.

B. Materials of construction and end fittings type shall be consistent with pipe material and equipment/pipe connection fittings.

C. Flexible loops shall consist of two (2) flexible sections of hose and braid, two (2) 90° elbows and a 180° return assembled in such a way that the piping does not change direction, but maintains its course along a single axis. Flexible loops shall have a factory supplied, center support nut located a t the bottom of the 180° return, and a drain/air release plug.

D. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be installed in a neutral, pre-compressed or pre-extended condition as required for the application.

E. Provide nested construction loops when installed in multiples. For steam service, loops must be installed with flexible legs horizontal to prevent condensate build up.

F. Provide guides and anchors as specified.

G. Loops shall be at 0 in. deflection at time of installation based upon 50°F ambient temperature. If the installation temperature is to be below 50°F, it is the Contractor's responsibility to review the installation with the Engineer before proceeding.

H. Make: Metraflex Co., or equal.

2.8 FLEXIBLE EXPANSION LOOPS

A. Provide flexible expansion loops of size and type as shown on the drawings, which will provide a flexible pipe loop that will absorb and compensate multi-plane movements simultaneously as well as reduce piping stress.

B. Materials of construction and end fittings type shall be consistent with pipe material and equipment/pipe connection fittings.

C. Construction to be 3 equal length sections of annular corrugated 321 stainless steel (or bronze) close-pitch hose with stainless steel (or bronze) overbraid that will absorb or compensate for pipe movements in all 6 degrees of freedom (3 coordinate axes, plus rotation above those axes) simultaneously.

D. The corrugated metal hose, braid(s) and a stainless steel ring-ferrule/band (material gauge not less than .048 in.) must be integrally seal welded using a 100% circumferential, full penetration TIG welds. End fittings shall be selected per application. Fittings must be attached using 100% circumferential TIG weld or oxyacetylene process with phos-copper filler.

E. Pre-manufactured flexible loops shall have UL 536 listing when handling flammable and combustible gases and liquids at pressures not exceeding 175 psi at ambient temperature.

F. Braided stainless steel Tri-Flex Loops must be suitable for operating temperatures up to 850°F (455°C). Braided bronze Tri-Flex Loops must be suitable for operating temperatures up to 400°F (204°C).

G. Tri-Flex Loop must be designed for pressure testing to 1.5 times their maximum rated working pressure and a minimum 4:1 (burst to working) safety factor.

H. Each braided Tri-Flex Loop shall be individually leak tested by the manufacturer using air-under-water or hydrostatic pressure.

I. Tri-Flex Loops shall be prepared for shipment using a cut-to-length metal shipping bar, tacked securely between the elbows of the two parallel legs, to maintain the manufactured length during shipping. Shipping bar must be removed prior to system start-up.

J. The pre-manufactured flexible loop shall be installed following the manufacturer's printed installation instructions, unless otherwise noted.

K. A hanger assembly kit shall be provided with each loop. Kit shall include two (2) UL listed seismic wire cables (13 ft. long), two (2) universal restraint clips, and four (4) zinc plated copper oval sleeves. Wire cable shall conform to the requirement of ASCE guidelines (pre-stretched and permanent end fittings maintained a breakstrength safety factory of two). A Felco Model C7 cable cutter and #1-3SBHS crimping tool shall also be included for proper assembly of hanging kit components.

L. Warranty:

1. Tri-Flex Loop must have a three (3) year full replacement warranty when installed in accordance with all specifications and installation instructions as described in the Flex-Hose Tri-Flex Loop Installation and Maintenance Instructions.

M. Make:

1. Tri-Flex Loop as manufactured by Flexhose or equivalent.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Equipment installed in accordance with the manufacturer's installation instructions.

B. Piping shall be properly anchored to control the direction of expansion and guided at the entrance to expansion devices.

C. Expansion compensators and joints are sized based upon an ambient temperature of 50°F at the time of installation. If the installation temperature is to be below 50°F, it is the Contractor's responsibility to review the installation with the Engineer before proceeding.

D. Provide piping system anchors and guides as shown on the plans. Where an anchor is shown at a change in piping direction, it shall fully control movement in both directions. In lieu of a single anchor fabricated for two directional control, two (2) individual anchors may be provided.

END OF SECTION

SECTION 230519 - GAUGES AND THERMOMETERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUBMITTAL

A. Submit product data for gauges, thermometers and thermowells.

PART 2 - PRODUCTS

2.1 WATER PRESSURE GAUGES

A. Construction to be Bourdon tube type; 4-1/2 in. diameter minimum, dial face, stamped stainless steel, replaceable glass lens, with snap-on rings. Phosphor bronze tube, bronze bushed rotary movement, silver brazed or soldered to brass socket and brass tip. 1/4 in. bottom connection. Accuracy, one (1.0) percent of included scale range. White dial face with black numerals, graduated in pounds; equipped with bronze pulsation dampener or snubber.

B. Make: American, Ashcroft, Crosby, Duro, Marsh, Moeller, Trerice, Weiss, Weksler, Winters.

2.2 PIPING SYSTEM THERMOMETERS

A. Industrial type, plastic, aluminum or steel case, glass or plastic front, non-toxic organic liquid filled, red reading column, white or silver V-shaped scale, black numerals. Union flange mounted, separable socket with thermowell, extension necks where required; range as called for service. Universal adjustable type, 9 in. scale. For installation in hot water systems, graduations of 2°F., accurate to within 1°F. For installation in water systems where the maximum temperature is less than 120°F, graduations of 1°F, accurate to within 1/2°F.

B. Make: American, Moeller, Trerice, Weiss, Weksler, Winters.

2.3 DIGITAL LIGHT POWERED THERMOMETER

A. High impact ABS case. Range for -40° to 300°F 3/8 in. LCD display. Accuracy of 1% of reading or 1°F, whichever is greater. 1/10° resolution. Internal potentiometer for recalibration. 10 LUX rating. 10 second updates. Ambient operating range of -30° to 140°F. Glass passivated thermistor sensor. Industrial glassstem assembly. Provide suitable thermowell.

B. Make: Weiss, Winters.

2.4 PRESSURE/TEMPERATURE TEST PLUGS

A. 1/4 in. NPT plug shall be capable of reading either a pressure or temperature. 1/8 in. o.d. dual seal core of Nordel 275°F with zero leakage from vacuum to 500 psig.

B. Test kit consisting of: one 2-1/2 in. test gauge 0-100 psi, one gauge adapter 1/8 in. probe, and two 5 in. stem pocket testing thermometers - one 0° to 220° and one 25° to 125°F.

C. Makes: Peterson Equipment Company, Sisco P/T plugs.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide where called for in the drawings and as noted below.

B. All gauges and thermometers shall be provided with pressure and temperature ranges appropriate for the system in which they are installed. Select to operate in the middle third of the range under normal operating conditions. Gauges and thermometers shall be suitable for the environment of their installed location, and if installed outdoors shall be acceptable for operation down to an ambient temperature of -20°F.

3.2 WATER PRESSURE GAUGES

A. Heating water and chilled water coils: 0 to 60 psi range.

B. Provide 1/4 in. ball valve in each pump inlet and outlet tapping, or in piping adjacent to same. Range 30 in. vacuum to 100 psi.

C. Heat exchangers: 0 to 60 psi range.

D. Compression tanks: 0 to 100 psi range.

E. Each water make-up valve assembly: 0 to 60 psi range.

3.3 THERMOMETERS

A. Provide thermowells mounted in oversize tee, or elbow if necessary, to provide as little restriction as possible to fluid flow. Provide thermometer stems and thermowell depths of proper length to allow accurate reading. Locate adjacent to control sensing equipment. Install and adjust angles so as to be easily read from floor.

B. Cooling Coil: Inlet and outlet; range 20° to 120°F.

C. Chillers: Supply and return; range 20° to 120°F.

D. Boiler: Inlet and outlet; range 30° to 300°F.

E. Hot Water Zone: Supply and return pipe; range 30° to 300°F.

F. Snow Melting: Supply and return; range 0° to 160°F.

G. Heating Coil: Inlet and outlet; range 0° to 220°F.

3.4 TEST PLUG

A. Provide test plugs at locations as called for.

END OF SECTION

SECTION 230523 - VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services as required for the complete installation and related Work designed in Contract Documents.

1.2 SUBMITTAL

A. Submit product data for valves and accessories.

PART 2 - PRODUCTS

2.1 VALVES

A. General: Valves shall have following requirements:

1. Working pressure stamped or cast on bodies.

2. Stem packing serviceable without removing valve from line.

3. Valves on insulated services shall have handle extensions so that the handle is fully beyond the insulation jacketing.

4. Where possible, all valves of like type shall be of a single manufacturer.

B. Acceptable Manufacturers:

1. Gate, Globe, and Check Valves: Apollo, Hammond, Milwaukee, Nibco, Watts, Victaulic.

2. Ball Valves: Apollo, Hammond, Jamesbury, Milwaukee, Watts, Nibco, Victaulic.

3. Butterfly Valves: Apollo, DeZurik, Jamesbury, Keystone, Milwaukee, Watts, Nibco, Victaulic.

4. High Performance Butterfly Valves: Keystone, Bray, Velan, Milwaukee.

5. To establish a standard of quality and to identify features, certain manufacturer's numbers are given in the following paragraphs.

C. Gate Valves:

1. 2-1/2 in. and Larger: Iron body, bronze solid wedge disc. OS&Y, flanged ends, rising stem, bolted bonnet, 125 lb. SWP, Milwaukee F-2885A.

2. 2 in. and Smaller: Bronze body, bronze solid wedge disc, rising stem, threaded or union bonnet, threaded ends, 125 SWP, Milwaukee 1152.

D. Globe Valves:

1. 2-1/2 in. and Larger: Iron body, bronze solid wedge disc, 125 SWP, flanged ends, bolted bonnet, Milwaukee F-2981-A.

2. 2 in. and Smaller: Bronze body, renewable composition or bronze disc, union bonnet, rising stem, threaded ends, 150 SWP, Milwaukee 590.

E. Check Valves:

1. 2-1/2 in. and Larger: Iron body, cast iron disc with bronze disc face rings and bronze seat ring, bolted flange cap, flanged ends, 125 SWP, Milwaukee F-2974-A.

2. 2 in. and Smaller: Bronze, swing check, threaded ends, 125 SWP, Milwaukee 1509.

3. Silent Check Valves, 2 in. and Smaller: Renewable seat, bronze body with bronze trim and stainless steel spring, 125 lb. SWP. Apollo 61-500 Series.

4. Silent Check Valves, 2 in. and Larger: Cast iron body, 304 stainless steel seat, disc, spring, bushing and screw, 125 lb. SWP. Milwaukee 1400.

5. Grooved End Spring-Loaded Check Valves:

a. 2 in. through 3 in.: Ductile iron body, stainless steel disc and spring, brass shaft, nickel-plated seat, 365 psi CWP. Victaulic Series 716H.

b. 4 in. through 12 in.: Ductile iron body, EPDM coated ductile iron disc, stainless steel spring and shaft, welded-in nickel seat, 300 psi CWP, Victaulic Series 716 or 779 with venture taps.

c. 14 in. through 24 in.: Ductile iron body, dual disc design, stainless steel disc, spring and shaft, EPDM seat bonded to the valve body, 230 psi CWP. Victaulic Series W715.

F. Ball Valves for Water Service:

1. For chilled and hot water systems 3 in. and under: Bronze body with hardened chrome-plated brass ball, glass reinforced or carbon impregnated PTFE seats, full porting, 600 lb., W.O.G., adjustable packing gland, insulated handle, screwed or soldered ends, blowout proof stem. Provide handle extension on insulated services.

2. Grooved end valves for chilled, hot and condenser water systems 1-1/2 in. through 6 in. ductile iron body, chrome plated carbon steel ball and stem, standard port, blowout proof, 800 psi CWP, lever handle or gear operator with hand wheel. Victaulic Series 726.

3. Provide extended operations handle on non-thermal conductive material and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

G. Ball valves for low pressure condensate systems. Same as above except with Type 316 stainless steel ball and stem. Rated for 150 lb. saturated service, Watts B6000SS.

H. Valves for Gauges and Instruments:

1. 1/4 in., bronze body, hardened chrome plated brass ball, glass reinforced carbon impregnated seats, standard porting, 400 lb. W.O.G., adjustable packing gland, screwed ends, tee handle, Watts B6000TH.

I. Grooved Butterfly Valves for Water Service:

1. Bi-directional bubble tight shutoff against working pressure of 300 psi.

2. Body: Grooved type, coated ductile iron.

3. Disc: Nickel coated ductile iron.

4. Seat: EPDM; pressure responsive in sizes through 12 inch.

5. Stem: Stainless steel with EPDM seals. Stem shall be offset from the disc centerline to provide complete 360 degree circumferential seating.

6. Operators: Valves up to 6 in. with lever operators; valves 8 in. and larger with heavy duty manual gear actuators.

7. Victaulic VIC-300 Master Seal (2 in. to 12 in.).

8. Victaulic VIC-AGS (14 in. to 24 in.).

J. Lug Type Butterfly Valves for Water Service:

1. Rated for working pressure 200 psi, bi-directional dead end service, bubble-tight.

2. Body: Lug type, cast iron ASTM A126, or ductile iron.

3. Disc: Aluminized bronze.

4. Seat: EPDM, resilient seat. Rated to 250^{o}F.

5. Stem: 316 or 416 stainless steel. Single offset.

6. Operator: Lockable Lever for sizes through 6 in. Manual hand wheel gear actuator for sizes 8 in. and larger.

7. Milwaukee CL223E (2 in. - 6 in.), CL323E (8 in. and larger), or Watts BF-03.

K. Gas Valves:

1. 2-1/2 in. and Larger: Manual actuated with level actuators bolted gland type, short pattern, lubricated plug type, 175 lb. WOG, flanged, Nordstrom, Fig. #143, UL listed.

2. 2 in. and Smaller: AGA/CGA and UL/FM listed for natural and LP gas, forged brass full port, threaded ends, Watts FBV Series.

L. Hose Thread Drain Valves:

1. Ball valve, bronze body, hardened chrome ball with hose thread end, cap and chain.

M. Fusible Link Valves:

1. Level type gate valve for emergency closing of oil supply line. Spring-operated, self closing type, with spring and 165°F fusible link. Bronze valve with malleable iron handle. Port full line size. Preferred Utilities Type 110.

N. Liquid or Vacuum Relief Valves:

1. Bronze base and bronze working parts except steel cadmium-plated springs; suitable for pressure up to 250 psi; non-pop valve suitable for use on boiler feed pump discharge, Lunkenheimer #658.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Provide valves of type called for and where required to service equipment.

2. Provide at major building and systems sections.

3. Provide chain wheels, guides, and chain loops for valves, where called for or in Mechanical Rooms where valves are mounted higher than 8'-0" AFF.

4. Isolating valves for individual fan convectors, room units, terminal units, or other similar apparatus may be inside cabinet or at connection to branch mains where accessible.

5. Locate valves with handles at horizontal position when 5 ft. or more above the floor, for greater visibility and easier use. Otherwise, locate valves with handles at or above horizontal position. Swing check valves in upright position only.

6. Butterfly valves may be used for water service over 2 in. unless otherwise noted.

7. Ball valves may be used for water service through 3 in., unless otherwise noted.

8. Provide hose threaded valves at low points, strainers, equipment, and as called for.

END OF SECTION

SECTION 230530 - ROOF CURBS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services as required for the complete installation of roof curbs as shown in Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230550 - Wind Restraint for HVAC Systems.

B. Section 230529 - Seismic and Wind Restraint for Mechanical Systems.

1.3 SUBMITTALS

A. Typical detail and schedule for equipment. Details shall include cross-sectional view illustrating clearly the type of curb being submitted, i.e. double wall insulated, with or without cant.

PART 2 - PRODUCTS

2.1 ROOF CURBS AND PIPE/DUCT/EQUIPMENT SUPPORTS

A. Basis of Design: Subject to compliance with requirements of this section, provide Roof Products and Systems Corp. (RPS) or comparable product by one of the following:

1. RPI (Roof Products Inc.)
2. ThyCurb
3. Greenheck

B. Configuration: Coordinate curb type with roof deck construction and insulation thickness.

1. Self-flashing without cant strip, with mounting flange (RPS Series 2A).
2. Built-in cant and mounting flange (RPS Series 3A).
3. Built-in raised cant and mounting flange (RPS Series 4A).

C. Provide wind restraint as called for in Item 1.2 above.

2.2 FAN CURBS/DUCT CURBS

A. Double wall, 1-1/2 in. minimum thickness, fully insulated in the interior cavity with rigid insulation. Curb constructed of galvanized steel, 1-1/2 in. 3# density insulation with continuous welded corner seams and painted at all welds. 20 gauge up to 36 in., 18 gauge 38 to 72 in., 16 gauge over 72 in. in any dimension.

B. Kitchen exhaust fan curbs shall be 24 in. high with hinges and service hold-open chain or cable; all other fan curbs shall be 18 in. high or as otherwise noted on the drawings.

C. Provide curb with adhesive backed closed cell foam gasket on the top edge to make airtight seal between curb and ventilator, fan, or air handling unit. Gasketing for kitchen exhaust fan curbs shall be woven ceramic gasket tape rated for the operating temperature.

D. Options:

1. Insulated curb extension with damper tray to allow access door for damper maintenance; access door shall be 10 in. high.

2. Sound Curb: Curb with sound-absorbing insulation.

3. Solid platform.

4. Vented Curb: Unlined with louvered vents in vertical sides. (kitchen exhaust only)

E. Basis of Design: RPS - RC Roof Curbs.

2.3 CURB ADAPTER - TRANSITION/EXTENSION

A. Curb adapter/extension for equipment requiring a curb connection equal, larger or smaller than an existing curb.

B. 18 gauge galvanized steel, double walled construction. 1-1/2 in. minimum thickness rigid insulation. Fully welded construction and painted at all welds. Neoprene gasket.

C. Basis of Design: RPS - CE-1 (equal) or CA-1 (larger) or CA-2 (smaller).

2.4 EQUIPMENT SUPPORTS

A. Double wall, minimum 18 in. high. Constructed of 18 gauge galvanized steel with continuous welded corner seams and painted at all welds. Constructed of heavier gauge steel where standard rail cannot support unit weight. Provide with top cap counter flashing. Width to be 5-1/2 inches.

B. Basis of Design: RPS - Equipment Rail ER2.

2.5 DUCT SUPPORTS

A. Double wall, minimum 18 in. high. Constructed of 18 gauge galvanized steel with continuous welded corner seams and painted at all welds. Constructed of heavier gauge steel where standard curb cannot support unit weight. Provide with top cap counter flashing. Width to be 5-1/2 inches.

B. Duct mounting pedestal shall consist of a support rail 12 in. longer than the duct width for single duct support, with a single galvanized steel slide channel equal in length to the equipment rail attached to galvanized steel "U" shaped mounting brackets secured to the side of the equipment rail with lag bolts. The duct mounting slide assembly shall be

sized to suit the duct supported and fabricated of galvanized steel and shall have galvanized 18 in. long continuous threaded rods to allow 12 in. vertical adjustment, and lateral adjust spacer bracket for 12 in. horizontal adjustment.

C. Basis of Design: RPS - Duct Mounting Pedestal.

2.6 PIPE SUPPORTS

A. Same construction as "Equipment Supports". Provide with full length steel bracket, U bolts and accessories as required to secure piping to the pipe support as detailed on Contract Drawings.

B. Basis of Design: RPS - Pipe Mounting Pedestal Model ER.

2.7 PIPE CURB ASSEMBLY - PIPE PORTAL

A. Fully insulated with rigid 1-1/2 in. 3# density insulation. Minimum 18 in. high. Constructed of 18 gauge galvanized steel with continuous welded corner seams and painted at all welds.

B. Acrylic coated ABS rib reinforced curb cover and integral counter flashing, size and number of pipe and conduit openings as required to suit job conditions.

C. EPDM protective rubber pipe boots and stainless steel clamps secured around each pipe individually. Curb provided with raised cant, flanged or recessed. Curb flange shall suit roof construction and type of insulation being applied.

D. Basis of Design: RPS - Pipe Portal Flashing System.

PART 3 - EXECUTION

3.1 GENERAL

A. Height as recommended by equipment manufacturer, not less than described in this specification. This Contractor shall be responsible for exact size, length, and location and shall set and secure each curb to the roof. Shim and level curb as required. Provide curb and supports for all roof-mounted equipment. All roof penetrations shall be made through an appropriate curb. All roof mounted equipment including fans, air handling units, etc, shall be set on an equipment support unless otherwise noted. Refer to Contract Drawings for details on plenums extending from curbs.

END OF SECTION

SECTION 230548 - VIBRATION ISOLATION OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install vibration control devices, materials, and related items. Perform all work as shown on the Drawings and as specified herein to provide complete vibration isolation systems in proper working order.

B. See Specification Section 230550 - Wind Restraint for Mechanical Systems.

1.2 MATERIAL AND EQUIPMENT

A. All vibration isolation mounts shall be supplied by one of the following approved manufacturers:

1.	Mason Industries Inc. (Hauppauge, NY)	M.I.
2.	Kinetics Noise Control Inc. (Dublin, OH)	K.N.C.
3.	Vibration Mountings & Controls Group. (Butler, NJ)	VMC Group
4.	Vibration Eliminator Co. (Long Island City, NY)	V.E.C.

1.3 QUALITY ASSURANCE

A. Coordinate the size, location and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

B. Provide vibration isolators of the appropriate sizes, with the proper loading to meet the specified deflection requirements.

C. Supply and install any incidental materials such as mounting brackets, attachments and other accessories as may be needed to meet the requirements stated herein even if not expressly specified or shown on the Drawings, without claim for additional payment.

D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specification.

E. Should any rotating equipment cause excessive noise or vibration when properly installed on the specified isolators, the Contractor shall be responsible for re-balancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

F. Upon completion of work, the Architect or the Architect's Representative shall inspect the installation and shall inform the installing contractor of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.

1.4 SUBMITTALS

A. Refer to related sections elsewhere for procedural instruction for submittals.

B. Before ordering any products, submit shop drawings of the items listed below. The shop drawings must be completed when submitted and must be presented in a clear, easily understood form. Incomplete or unclear presentation of shop drawings may be reason for rejection of the submittal.

C. A complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.

D. Detailed selection data for each vibration isolator supporting equipment, including:

1. The equipment identification mark.

2. The isolator type.

3. The actual load.

4. The static deflection expected under the actual load.

5. The specified minimum static deflection.

6. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method, and location of equipment attachment bolts.

7. Special details necessary to convey complete understanding of the work to be performed.

E. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job if requested. All costs associated with submission of samples shall be borne by the Contractor.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

A. General:

1. All springs installed out-of-doors shall be zinc electroplated or powder-coated after fabrication. Hardware and other metal parts shall be cadmium-plated or galvanized. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.

2. All isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.

3. Isolator types are scheduled to establish minimum standards. At the Contractor's option, labor-saving accessories can be an integral part of isolators supplied to

provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories and seismic restraint features must not degrade the isolation performance of the isolators.

4. Static deflection of isolators shall be as provided in the EXECUTION section and as shown on the Drawings. All static deflections stated are the minimum acceptable deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be disapproved.

B. Type FSN (Floor Spring and Neoprene):

1. Spring isolators shall be freestanding and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Springs shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately 1 (one). All mounts shall have leveling bolts. The spring element in the isolator shall be set in a neoprene cup and have a steel washer or a flat surface in contact with the neoprene to distribute the load evenly over the bearing surface of the neoprene. Alternatively, each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, a rectangular bearing plate of appropriate size shall be provided to load the pad uniformly within the manufacturer's recommended range. If the isolator is to be fastened to the building and the NP isolator is used, grommets shall be provided for each bolt hole in the base plate. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum bearing plate shall be used between the friction pad and the NO isolator. If the isolator is outdoors, bearing plates shall not be made of galvanized steel. The NP isolator, beating plate and friction pad shall be permanently adhered to one another and to the bottom of the isolator base plate.

2. Type FSN isolators shall be one of the following products with the appropriate neoprene pad (if used) selected from Type NP or approved equal:

a.	Type SLF	M.I.
b.	Type FDS	K.N.C.
c.	Series A	VMC Group

C. Type FSNTL (Floor Spring and Neoprene Travel Limited):

1. Spring isolators shall be freestanding and laterally stable. Spring diameter shall not be less than 0.8 of the compression height of the spring at the rated load. Spring shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one (1). All mounts shall have leveling bolts. All mounts shall have vertical travel limit stops to control extension when weight is removed. The travel limit stops shall be capable of serving as blocking during

erection of the equipment. A minimum clearance of 1/4 in. shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.

2. The spring element in the isolator shall be set in a neoprene cup and have a steel washer or a flat surface in contact with the neoprene to distribute the load evenly over the bearing surface of the neoprene. Alternatively, each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, a rectangular bearing plate of appropriate size shall be provided to load the pad uniformly within the manufacturer's recommended range. If the isolator is to be fastened to the building and the NP isolator is use, grommets shall be provided for each bolt hole in the base plate.

3. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum bearing plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, bearing plates shall not be made of galvanized steel. The NP isolator, bearing plate and friction pad shall be permanently adhered to one another and to the bottom of the isolator base plate.

4. Type FSNTL isolators shall be one of the following products, with the appropriate neoprene pad (if used) selected from Type NP or approved equal:

   a. Type SLR M.I.

   b. Type FLS K.N.C.

   c. Series AWR VMC Group

D. Type FN (Floor Neoprene):

1. Neoprene isolators shall be neoprene-in-shear type with steel reinforced top and base. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed. Bolt holes shall be provided in the base and the top shall have a threaded fastener. The mounts shall include leveling bolts that may be rigidly connected to the equipment.

2. Type FN isolators shall be one of the following products or approved equal:

   a. Type ND M.I.

   b. Type RD K.N.C.

   c. Series RD VMC Group

E. Type NP (Neoprene Pad):

1. Neoprene pad isolators shall be one layer of 1/4 in. to 3/8 in. thick ribbed or waffled neoprene. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.

2. Type NP isolators shall be one of the following products or approved equal:

a.	Type W	M.I.
b.	Type NPS	K.N.C.
c.	Series Shear Flex	VMC Group

F. Type DNP (Double Neoprene Pad):

1. Neoprene pad isolators shall be formed by two layers of 1/4 in. to 3/8 in. thick ribbed or waffled neoprene, separated by a galvanized steel, stainless steel or aluminum plate. If the isolator is outdoors, the plate shall not be made of galvanized steel. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.

2. Type DNP isolators shall be formed from one of the following products or approved equal:

a.	Type WSW	M.I.
b.	Type NPS	K.N.C.
c.	Series Shear Flex	VMC Group

G. Type HSN (Hanger Spring and Neoprene):

1. Vibration isolator hangers shall consist of a free standing and laterally stable steel spring and a neoprene element in series, contained within a steel housing. Spring diameters and hanger housing lower hole size shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the housing. Alternatively, other provisions shall be made to allow for a 30° arc of movement of the bottom hanger rod without contacting the isolator housing. Spring diameter shall not be less than 0.8 of the compressed height of the spring at the rated load. Spring elements shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. The neoprene element shall be designed to have a 0.3 in. minimum static deflection. The deflection of both the spring element and the neoprene element shall be included in determining the overall deflection of Type HSN isolators.

2. Type HSN isolators shall be one of the following products or approved equal:

a.	Type 30N	M.I.
b.	Type SRH or SFH	K.N.C.
c.	Type RSH or RFH	VMC Group

H. Type HN (Hanger Neoprene):

1. Vibration isolator hangers shall consist of a neoprene-in-shear element contained within a steel housing. A neoprene neck brushing shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30° arc before contacting the hanger housing.

2. Type HN isolators shall be one of the following products or approved equal:

a.	Type HD	M.I.
b.	Type RH or FH	K.N.C.
c.	Type RHD or RFD	VMC Group

2.2 EQUIPMENT BASES

A. Type BSF (Base-Steel Frame):

1. Steel base frames shall consist of structural steel section sized, spaced, and connected to form a rigid base which will not twist, rack, deform, or deflect in any manner which will negatively affect the operation of the supported equipment or the vibration isolation mounts. Frames shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. The depth of steel frame shall be at least 1/10 the longest dimension of the base and not less than 6 in. The base footprint shall be large enough to provide stability for supported equipment.

2. Frame bases shall include side mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment.

3. Type BSF bases shall be supplied by the isolator manufacturer and shall be one of the following products or approved equal:

a.	Type WFSL	M.I.
b.	Type SFB or SRB	K.N.C.
c.	Series WFB	VMC Group

B. Type BIB (Base-Inertia Base):

1. Concrete inertia bases shall be formed of stone-aggregate concrete (150 lb./cu. ft.) and appropriate steel reinforcing cast between welded or bolted perimeter structural steel channels. Inertia bases shall be built to form a rigid base that will not twist, rack, deform, deflect, or crack in any manner that would negatively

affect the operation of the supported equipment or the vibration isolation mounts. Inertia bases shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. Inertia base depth shall be at least 1/12 the longest dimension of the inertia base and not less than 6 in. The base footprint shall be large enough to provide stability for supported equipment. Inertia bases shall include side mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment.

2. The steel frame and reinforcement shall be supplied by the vibration isolator manufacturer.

3. Frame and reinforcement for Type BIB bases shall be one of the following products or approved equal:

   a. Type KSL M.I.

   b. Type CIB-L or CIB-H K.N.C.

   c. Series WPF VMC Group

2.3 RESILIENT PENETRATION SLEEVE/SEAL

A. Resilient penetration sleeve/seals shall be field-fabricated from a pipe or sheet metal section that is 1/2 in. to 3/4 in. larger than the penetrating element in all directions around the element, and shall be used to provide a sleeve through the construction penetrated. The sleeve shall extend 1 in. beyond the penetrated construction on each side. The space between the sleeve and the penetrating element shall be packed with glass fiber or mineral wool to within 1/4 in. of the ends of the sleeve. The remaining 1/4 in. space on each end shall be filled with acoustical sealant to form an airtight seal. The penetrating element shall be able to pass through the sleeve without contacting the sleeve. Refer to details on Drawings.

2.4 RESILIENT LATERAL SUPPORTS

A. These units shall either be a standard product of the vibration isolation mounting manufacturer, or be custom fabricated from standard components. These units shall incorporate neoprene isolation elements similar to Type FN that are specifically designed to provide resilient lateral bracing of ducts or pipe.

B. Resilient lateral supports shall be one of the following products or approved equal:

   1. Type ADA M.I.

   2. Type RGN K.N.C.

   3. Type MDPA VMC Group

2.5 FLEXIBLE DUCT CONNECTIONS

A. Flexible duct connections shall be heavy glass fabric, double neoprene coated, approximately 30 oz. per sq. yd. The clear space between connected parts shall be a minimum of 3 in. and the connection shall have a minimum of 1.5 in. of slack material. Materials for flex connection shall be fire retardant, water and milder resistant, and comply with UL standard 214.

B. Flexible duct connections shall be one of the following products or approved equal:

1. Ventfabrics, Inc. "Ventglass".

2.6 FLEXIBLE PIPE AND PUMP CONNECTIONS (DOUBLE SPHERE)

A. Flexible pipe connections shall be fabricated of multiple plys of nylon cord, fabric, and neoprene; and shall be vulcanized so as to become inseparable and homogeneous. Flexible connections shall be formed in a double sphere shape, and shall be able to accept compressive, elongating, transverse, and angular movements. The flexible connections shall be selected and specifically fitted, if necessary, to suit the system temperature, pressure, and fluid type. In addition, suitable flexible connections should be selected which do not require rods or cables to control extension of the connector.

B. Connectors for pipe sizes 2 in. or smaller shall have threaded female union couplings on each end. Larger sizes shall be fitted with metallic flange couplings.

C. Flexible pipe connections shall be one of the following or approved equal:

1.	Type Twin Sphere	Metraflex
2.	Type MFTNC or MFTFU	M.I.

2.7 FLEXIBLE PIPE AND PUMP CONNECTIONS (BRAIDED STAINLESS STEEL)

A. Braided stainless steel pump and pipe connector(s) shall be constructed of annular corrugated stainless steel close-pitch hose with stainless steel overbraid. The corrugated metal hose, braid(s) and a stainless steel ring-ferrule/band (material gauge not less than .048 in.) shall be integrally seal-welded using a 100% circumferential, full-penetration TIG weld. Fittings shall be attached using a 100% circumferential TIG weld.

B. Braided stainless steel pump and pipe connector(s) must be suitable for operating temperatures up to 850°F. The rated working pressure of the braided metal hose must have a minimum 4:1 safety factor.

C. Each braided stainless steel connector shall be individually leak tested by the manufacturer using air-under-water or hydrostatic pressure.

D. Braided stainless steel connectors shall carry a three (3) year warranty when installed in accordance with all specifications and installation instructions as described by the manufacturer.

E. End fittings shall be flat-faceplate steel flanges with 150# ANSI drilling, and outside diameter, carbon steel MPT ends, flanged by Schedule 40 grooved ends or increasing ends.

F. Acceptable Manufacturers: Flexhose Pumpsaver or equivalent Keflex, Metraflex, Mason-Mercer.

2.8 THRUST RESTRAINTS

A. Thrust restraints shall consist of a spring element in series with a neoprene pad. The unit shall be designed to have the same deflection due to thrust-generated loads as specified for the isolators supporting the equipment. The spring element shall be contained within a steel frame and be designed so it can be pre-compressed at the factory to allow for a maximum of 1/4 in. movement during starting or stopping of the equipment. Allowable movement shall be field-adjustable. The assembly shall be furnished complete with rods and angle brackets for attachment to both equipment and the adjacent fixed structural anchor. The thrust restraints shall be installed on the discharge of the fan so that the restraint rods are in tension. Assemblies that place the rods in compression are not acceptable. The holes in the spring restraint brackets through which the restraint rods pass must be oversized to prevent contact between the brackets and rods.

B. Thrust restraints shall be one of the following products or an approved equal:

1.	Type WB	M.I.
2.	Type HSR	K.N.C.
3.	Type HTR	VMC Group

2.9 GROMMETS

A. Grommets shall be specially formed to prevent bolts from directly contacting the isolator base plate, and shall be sized so that they will be loaded within the manufacturer's recommended load range.

B. Grommets shall either be custom made by combining a neoprene washer and sleeve, or be one of the following products or an approved equal:

1.	Type Isogrommets	MBIS, Inc. (Bedford Heights, OH)
2.	Type WB	Barry Controls (Brighton, MA)
3.	Type HG	Mason Industries Inc., (Hauppauge, NY)

2.10 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes as described in this specification shall be silicone or one of the non-setting sealants indicated below:

1.	Acoustical sealant	D.A.P.

2. BR-96 Pecora

3. Acoustical sealant Tremco

4. Acoustical sealant U.S.G.

PART 3 - EXECUTION

3.1 APPLICATION

A. General:

1. Refer to the PRODUCTS section of this specification for vibration isolation devices identified on the Drawings or specified herein.

2. The static deflection of all isolators specified herein are the minimum acceptable deflections for the mounts under actual load. Isolators selected solely on the basis of rated deflection are not acceptable and will be disapproved.

B. Major Equipment:

1. Unless otherwise shown or specified on Drawings, all floor-mounted major equipment shall be set on 6 in. high concrete housekeeping pads.

2. Types and minimum static deflections of vibration isolation devices for major equipment items shall be as specified hereunder.

3. Flexible duct connections shall be installed at all fan unit intakes, fan unit discharges, and wherever else shown on the Drawings.

4. Flexible pipe connections shall be installed at all pipe connections to vibration-isolated equipment and as indicated on Drawings in the positions shown on the Drawings.

5. Electrical connections to vibration-isolated equipment shall be flexible, as called for in the electrical portion of the specification.

6. Thrust restraints shall be installed on all suspended fans and on all floor-mounted fans developing 4 in. or more of static pressure, unless the horizontal component of the thrust force can be demonstrated to be less than 10% of the equipment weight.

C. Equipment Vibration Isolation Schedule:

TYPE	VIBRATION ISOLATOR TYPE	MINIMUM STATIC DEFLECTION (In.)	EQUIPMENT BASE
Chiller	FSNTL	.75	----
Base Mounted Pumps (Note 1)	FSN	.75	BIB
Inline Pumps	HSN	.75	----
Boilers	DNP	NA	----

TYPE	VIBRATION ISOLATOR TYPE	MINIMUM STATIC DEFLECTION (In.)	EQUIPMENT BASE
Inline Fans	HSN	1.5	----

NOTE 1: Equipment base and vibration isolators can be deleted where pumps are provided on slabs on grade and if pumps are placed on concrete inertia slab isolated from surrounding floor slab.

D. Miscellaneous Mechanical Equipment:

1. Miscellaneous pieces of mechanical equipment such as converters, pressure reducing stations, dryers, strainers, storage tanks, condensate receiver tanks and expansion tanks which are connected to isolated piping systems shall be vibration-isolated from the building structure by Type NP or Type HN isolators (selected for .01 in. static deflection) unless their position in the piping system requires a higher degree of isolation as called for under "Pipe Isolation".

E. Pipes:

1. All chilled water, condenser water, hot water, steam main and engine exhaust piping shall be isolated from the building structure within the following limits:

a. Within mechanical rooms.

b. Within 50 ft. total pipe length of connected vibration-isolated equipment (chillers, pumps, air handling units, pressure reducing stations, etc.).

c. Piping shall be isolated from the building structure by means of vibration isolators, resilient lateral supports, and resilient penetration sleeve/seals.

d. Isolators for the first three support points adjacent to connected equipment shall achieve one half the specified static deflection of the isolators supporting the connected equipment. When the required static deflection of these isolators is greater than 1/2 in., Type FSN or Type HSN isolators shall be used. When the required static deflection is less than or equal to 1/2 in., Type FN or Type HN isolators shall be used. All other pipe support isolators within the specified limits shall be either Type FN or Type HN achieving at least 1/4 in. static deflection.

e. Where lateral support of pipes is required within the specified limits, this shall be accomplished by use of resilient lateral supports.

f. Pipes penetrating the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.

g. Provide flexible pipe connections as called for under "Major Equipment" above and wherever shown on the Drawings.

3.2 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General:

1. Locations of all vibration isolation devices shall be selected for ease of inspection and adjustment as well as for proper operation.

2. Installation of vibration isolation equipment shall be in accordance with the manufacturer's instructions.

B. Isolators:

1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.

2. Isolators for equipment with bases shall be located on the sides of the bases which are parallel to the equipment shaft unless this is not possible because of physical constraints.

3. Locate isolators to provide stable support for equipment, without excess rocking. Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be provided to maintain stability of supported equipment, whether or not such a base is specifically called for herein.

4. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad.

5. Hanger rods for vibration-isolated support shall be connected to structural beams or joists, not the floor slab between beams and joists. Provide suitable intermediate support members as necessary.

6. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360° about the rod axis without contacting any object.

7. Parallel running pipes may be hung together on a trapeze, when allowed by Section 232010 that is isolated from the building. Isolator deflections must be the greatest required by the provisions for pipe isolation for any single pipe on the trapeze. Do not mix isolated and un-isolated pipes on the same trapeze.

8. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.

9. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.

10. The installed and operating heights of equipment vibration-isolated with Type FSNTL isolators shall be identical. Limit stops shall be out of contact during

normal operation. Adjust isolators to provide 1/4 in. clearance between the limit stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.

11. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Bases:

1. No equipment unit shall bear directly on vibration isolators unless its own frame is suitable rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements, and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.

2. Unless otherwise indicated, there is to be a minimum operating clearance of 1 in. between steel rails, steel frame base or inertia bases and the floor beneath the equipment. The isolator mounting brackets shall be positioned and the isolators adjusted so that the required clearance is maintained. The clearance space shall be checked by the Contractor to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.

D. Flexible Duct Connections:

1. Sheet metal ducts and plenum openings shall be squarely aligned with the fan discharge, fan intake, or adjacent duct section prior to installation of the flexible connection, so that the clear length is approximately equal all the way around the perimeter. Flexible duct connections shall not be installed until this provision is met. There shall be no metal-to-metal contact between connected sections, and the fabric shall not be stretched taut.

E. Flexible Pipe Connections:

1. Install flexible pipe connections in strict accordance with the manufacturer's instructions.

F. Thrust Restraints:

1. Thrust restraints shall be attached on each side of the fan at the vertical centerline of thrust. The two rods of the thrust restraints shall be parallel to the thrust force. This may require custom brackets or standoffs. The body of the thrust restraint shall not come in contact with the connected elements. Thrust restraints shall be adjusted to constrain equipment movement to the specified limit.

G. Grommets:

1. Where grommets are required at hold down bolts of isolators, bolt holes shall be properly sized to allow for grommets. The hold down bolt assembly shall

include washers to distribute load evenly over the grommets. Bolts and washers shall be galvanized.

H. Resilient Penetration Sleeve/Seals:

1. Maintain an airtight seal around the penetrating element and prevent rigid contact between the penetrating element and the building structure. Fit the sleeve tightly to the building construction and seal airtight on both sides of the construction penetrated with acoustical sealant.

END OF SECTION

SECTION 230550 - WIND RESTRAINT FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Support and brace mechanical and electrical systems, as called for, to resist directional wind forces (lateral, longitudinal and vertical).

1.2 APPLICABLE CODES AND STANDARDS

A. Provide work in compliance with the following codes and standards:

1. 2020 Building Code of New York State (Section 1609 and 1613).

2. 2020 Mechanical Code of New York State (Section 301, Item 301.15).

3. American Society of Civil Engineers (ASCE) Minimum Design Loads for Buildings and Other Structures with Supplement No. 1 - Standard ASCE/SEI 7-16.

1.3 QUALITY ASSURANCE

A. General:

1. The contractor shall provide Professional Engineer stamped and signed engineering calculations and details of wind restraint systems to meet total design lateral force requirements for support and restraint of mechanical systems. Engineer shall be licensed to practice in the state in which the project is located.

2. The wind restraint engineering calculations and details shall provide the quantity of attachments and size/type of attachments for the mounting of an equipment curb or support rail to the building structure, and for attachment of the equipment or system to the equipment curb or support rail. It is not the intent for manufactured equipment curbs or support rails to be certified by their respective manufacturers, nor is it the intent for them to be certified by the Professional Engineer who is providing the wind restraint calculations and connection methodology.

3. Systems requiring wind restraint including, but not limited to:

a. Rooftop units.
b. Exhaust fans.
c. Air cooled chillers.
d. Condensing units.
e. Ductwork.
f. Roof curbs and pipe/duct/equipment supports associated with any of the equipment listed above.

1.4 SUBMITTALS

A. Submit wind force level (Fp) calculations from applicable building code. Submit pre-approved restraint selections, installation details, and plans indicating locations of restraints.

B. Calculations, plans, restraint selection, and installation details shall be stamped and signed by a professionally licensed engineer experienced in wind restraint design.

C. Submit manufacturer's product data.

D. For each piece of equipment that requires wind restraint as outlined in this section, include the following:

1. Dimensioned Outline Drawings of Equipment Unit: Identify the center of gravity and locate and describe mounting and anchoring provisions.

2. Anchorage: Provide detailed description of equipment anchorage devices on which the calculations are based and their installation requirements. Identify anchor bolts, studs and other mounting devices. Provide information on the size, type and spacing of mounting brackets, holes and other provisions.

E. The Contractor shall provide photographs of the installed roof mounted equipment, showing the fully installed wind restraint anchoring, prior to the roofing material installation, as a formal submittal for verification that the work has been completed.

PART 2 - PRODUCTS

2.1 CODE INFORMATION

A. This project is subject to the wind bracing requirements of the codes listed above. The following criteria are applicable to this project:

1. Basic Design Wind Speed (V): 115 mph.

2. Risk Category: II

3. Exposure Category: C

4. Height and Exposure Adjustment Coefficient: Building height is less than 60 ft.

2.2 WIND BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

A. General:

1. Design analysis shall include calculated dead loads, wind loads, and capacity of materials utilized for the connection of the equipment or system to the structure.

2. Analysis shall detail anchoring methods, fastener sizes and spacing, etc.

3. All wind restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in Section 2.1.

B. Friction from gravity loads shall not be considered resistance to wind forces.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wind Restraint of Piping:

1. All restraint systems shall be installed in strict accordance with the wind restraint design submittal.

2. Installation of restraints shall not cause any change in position of equipment or piping, resulting in stresses or misalignment.

B. Wind Restraint of Ductwork and Equipment:

1. All restraint systems shall be installed in strict accordance with the wind restraint design submittal.

2. The interaction between mechanical and electrical equipment and the supporting structures shall be designed into the restraint systems.

3. Installation of restraints shall not cause any change in position of equipment or ductwork, resulting in stresses or misalignment.

4. Exhaust fans with hinge kits shall have wind restraint fasteners installed on the hinged side, same as the three (3) non-hinged sides.

5. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.

6. Do not install any equipment or duct that makes rigid connections with the building unless isolation is not specified.

7. Prior to installation, bring to the Architect's/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.

END OF SECTION

SECTION 230553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services as required for the complete installation designed in Contract Documents.

1.2 QUALIFICATION

A. All identification devices shall comply with ANSI/ASME A13.1 for lettering size, length of color field, colors and viewing angles.

1.3 SUBMITTALS

A. Submit manufacturer's technical product data and installation instructions for each identification material and device. Submit valve schedule for each piping system typewritten on an 8-1/2 in. x 11 in. (minimum) indicating valve number, location, and valve function. Submit schedule of pipe, equipment and name identification for review before stenciling or labeling.

1.4 MAKES

A. Allen Systems, Inc.; Brady (W.H.) Co.; Signmark Div.; Industrial Safety Supply Co., Inc.; Seton Name Plate Corp.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide manufacturer's standard products of categories and types required for each application. In cases where this is more than one type specified for an application, selection is installer's option, but provide single selection for each product category.

B. All adhesives used for labels in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits as called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

2.2 PIPING IDENTIFICATION

A. Identification Types:

1. Pressure Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers complying with ANSI/ASME A13.1. Provide a 360° wrap of flow arrow tape at each end of pipe label.

2. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color coded pipe markers, complying with ANSI/ASME A13.1.

3.

O.D. Pipe or Covering	Letter Size
3/4 in., 1 in., 1-1/4 in.	1/2 in.
1-1/2 in., 2 in.	3/4 in.
2-1/2 in. and over	1 in.

B. Lettering:

1. Piping labeling shall conform to the following list:

Pipe Function	Identification
Pumped Condensate	PC
Heating Water Supply	HWS
Heating Water Return	HWR
Chilled Water Supply	CWS
Chilled Water Return	CWR
Glycol Supply	GS
Glycol Return	GR

2.3 VALVE IDENTIFICATION

A. Valve Tags:

1. Standard brass valve tags, 2 in. diameter with 1/2 in. high numerals. Identify between heating and plumbing services with 1/4 in. letters above the valve number. Lettering to be stamped and in-filled black. Seton, or equal.

a. Valve-tag Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Chart:

1. Provide valve chart for all valves tagged as a part of this project. Frame and place under clear glass. Hang in Mechanical Room.

2. Valve chart to include as a minimum, valve #, valve size, valve type, valve service description, valve location.

2.4 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, phenolic (micarta) labels for mechanical engraving, 1/8 in. thick, and having predrilled holes for attachment hardware.

2. Letter Color: White.

3. Background Color: Black.

4. Maximum Temperature: Able to withstand temperatures up to 160 F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 in. by 3/4 in.

6. Minimum Letter Size: 1/4 in. for name of units if viewing distance is less than 24 in., 1/2 in. for viewing distances up to 72 in., and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2 in. x 11 in. bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

D. Provide for the following equipment:

1. Air handling units

2. Pumps

3. Chillers

4. Heat exchangers

5. Condensate pumps

2.5 ABOVE CEILING EQUIPMENT LOCATOR

A. 3/4 in. diameter adhesive stickers placed on ceiling grid. Color coded. Provide for the following:

1. Fire dampers/smoke dampers - RED

2. Plumbing valves - BLUE

3. HVAC valves - ORANGE

4. VAV boxes or reheat coils - GREEN

5. Fans - YELLOW

6. Pumps - BLACK

PART 3 - EXECUTION

3.1 GENERAL

A. Provide valve tags for all valves provided on project, except for service valves at terminal equipment.

B. Provide equipment tags for all equipment listed above.

C. Provide above ceiling equipment locator stickers on ceiling grid for all equipment listed above.

D. Provide piping identification with directional flow arrows for all piping on project, at maximum intervals of 20 ft. For piping installed through rooms, provide at least one pipe label in each room, for each pipe function.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for complete adjusting and balancing Work as required in Contract Documents.

B. This Section specifies the requirements and procedures of, mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

C. Test, adjust, and balance the following mechanical systems:

1. Supply air systems, all pressure ranges; including constant volume and variable volume systems.

2. Return air systems.

3. Exhaust air systems; including kitchen exhaust systems.

4. Hydronic systems; including constant flow and variable flow systems.

5. Laboratory Fume Hoods.

D. This Section does not include:

1. Testing boilers and pressure vessels for compliance with safety codes;

2. Specifications for materials for patching mechanical systems;

3. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.

4. Requirements and procedures for piping and ductwork systems leakage tests.

1.2 SUBMITTALS

A. Provide information in report form listing items required by specifications. Results shall be guaranteed. Contractor shall be subject to recall to site to verify report information before acceptance of the report by the Owner's Representative.

B. Strategies and Procedures Plan: Within thirty (30) days of Contractor's Notice to Proceed, submit testing and balancing strategies and step-by-step procedures as specified in Section 3.1.B, "Preparation", and consistent with those listed in Part 3 of this specification.

C. System Readiness Checklists: Within thirty (30) days of Contractor's Notice to Proceed, AABC agency shall provide system readiness checklists as specified in Section 3.1.C,

"Preparation", to be used and filled out by the installing contractors verifying that systems are ready for Testing and Balancing.

D. Examination Report: Provide a summary report of the examination review required in Section 3.1.D to the Engineer, documenting issues that may preclude the proper testing and balancing of the systems.

E. Certified report format shall consist of the following:

1. Title sheet with job name, contractor, engineer, date, balance contractor's name, address, telephone number and contact person's name and the balancing technician's name.

2. Individual test sheets for air handlers, terminal units, air distribution, exhaust fans, duct traverses, pumps, air handling coils, reheat coils, radiation, convectors, cabinet unit heaters and unit ventilators.

3. Manufacturer's pump and fan curves for equipment installed with design and actual operating conditions indicated.

4. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

1.3 DEFINITIONS

A. System testing, adjusting and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:

1. The balance of air and water distribution;

2. Adjustment of total system to provide design quantities;

3. Electrical measurement;

4. Verification of performance of all equipment and automatic controls.

B. Test: To determine quantitative performance of equipment.

C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

F. Report Forms: Test data sheets arranged for collecting test data in logical order for submission and review. This data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

G. Terminal: The point where the controlled fluid enters or leaves the distribution system. There are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return supply or outside air inlets or outlets on terminals such as registers, grilles, diffusers, and louvers.

H. Main: Duct or pipe containing the system's major or entire fluid flow.

I. Submain: Duct or pipe containing part of the systems' capacity and serving two or more branch mains.

J. Branch Main: Duct or pipe serving two or more terminals.

K. Branch: Duct or pipe serving a single terminal.

1.4 QUALIFICATIONS

A. Follow procedures and methods published by one or more of the following:

1. Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB).

2. Individual manufacturer requirements and recommendations.

B. Maintain qualified personnel at project for system operation and trouble shooting. TAB contractor shall change sheaves and perform mechanical adjustments in conjunction with balancing procedure.

C. Balancing contractor shall be current member of AABC or NEBB.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in the *AABC National Standards for Total System Balance.*

1.5 GENERAL REQUIREMENTS

A. Before concealment of systems visit the job site to verify and advise on type and location of balancing devices and test points. Make changes as required to balance facilities.

B. Place systems in satisfactory operating condition.

1. Adjusting and balancing shall be accomplished as soon as the systems are complete and before Owner takes possession.

2. Prior to balancing, adjust balancing devices for full flow; fill, vent and clean hydronic systems, replace temporary filters and strainers.

3. Initial adjustment and balancing to quantities as called for or as directed by the engineer, to satisfy job conditions.

4. All outdoor conditions (Db, Wb, and a description of the weather conditions) at the time of testing shall be documented in the report.

5. Provide sheaves and belts as required to meet system performance requirements for all belt-driven fan motors 10 HP and greater. Adjust and align sheaves to obtain proper settings and operation. Verify motors are not overloading.

6. Installing contractor shall replace balancing cocks, flow balancers and dampers in new systems that cannot be manipulated to satisfy balancing requirements.

7. Identify flow balancers, balancing cocks and dampers in existing systems that cannot be manipulated to satisfy balancing requirements.

8. Traverse main ducts to determine total system air quantities after all outlets have been set prior to final adjustment if the system does not meet design requirements. A sum of room CFM's is not acceptable.

9. If duct construction and/or installation prohibits proper traverse readings, provide coil measurements at main coils and/or fresh air intake traverse with units operating in 100% outside air mode (where applicable).

1.6 CONTRACTOR RESPONSIBILITIES

A. Provide Testing and Balancing agency one complete set of contract documents, change orders, and approved submittals in digital and hard copy formats.

B. Controls contractor shall provide required BAS hardware, software, personnel and assistance to Testing and Balancing agency as required to balance the systems. Controls Contractor shall also provide trending report to demonstrate that systems are complete.

C. Coordinate meetings and assistance from suppliers and contractors as required by Testing and Balancing agency.

D. Provide additional valves, dampers, sheaves and belts as required by Testing and Balancing agency.

E. Flag all manual volume dampers with fluorescent or other high-visibility tape.

F. Provide access to all dampers, valves, test ports, nameplates and other appurtenances as required by Testing and Balancing agency.

G. Installing contractor shall replace or repair insulation as required by Testing and Balancing agency.

H. Have the HVAC systems at complete operational readiness for Testing and Balancing to begin. As a minimum verify the following:

1. Airside:

a. All ductwork is complete with all terminals installed.

b. All volume, smoke and fire dampers are open and functional.

c. Clean filters are installed.

d. All fans are operating, free of vibration, and rotating in correct direction.

e. ASD start-up is complete and all safeties are verified.

f. System readiness checklists are completed and returned to Testing and Balancing agency.

2. Hydronics:

a. Piping is complete with all terminals installed.

b. Water treatment is complete.

c. Systems are flushed, filled and air purged.

d. Strainers are pulled and cleaned.

e. Control valves are functioning per the sequence of operation.

f. All shutoff and balance valves have been verified to be 100% open.

g. Pumps are started, and proper rotation is verified.

h. Pump gauge connections are installed directly at the pump inlet and outlet flange or in discharge and suction pipe prior to any valves or strainers.

i. ASD start-up is complete and all safeties have been verified.

j. System readiness checklists are completed and returned to Testing and Balancing agency.

I. Promptly correct deficiencies identified during Testing and Balancing.

J. Maintain a construction schedule that allows the Testing and Balancing agency to complete work prior to occupancy.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide tools, ladders, recording meters, gauges, thermometers, velometers, anemometers, Pitot tubes, inclined gauge manometers, magnehelic gauges, amprobes, voltmeters, psychrometers and tachometers required.

B. Instrumentation Calibration: Calibrate instruments at least every six (6) months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine Bid Documents and submittals and notify Owner's Representative and Engineer of any questions regarding balancing.

1. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper Testing and Balancing of systems and equipment.

2. Examine the approved submittals for HVAC systems and equipment.

3. Examine equipment performance data including fan and pump curves.

B. Prepare a Testing and Balancing Strategies and Procedures Plan that includes:

1. Equipment and systems to be tested.

2. Strategies and step-by-step procedures for balancing the systems.

3. Instrumentation to be used.

4. Sample forms with specific identification for all equipment.

C. Prepare system-readiness checklists, as described in the *AABC National Standards for Total System Balance*, for use by contractors in verifying system readiness for Testing and Balancing. These shall include, at a minimum:

1. Airside:

a. All ductwork is complete with all terminals installed.

b. All volume, smoke and fire dampers are open and functional.

c. Clean filters are installed.

d. All fans are operating, free of vibration, and rotating in correct direction.

e. Permanent electrical power wiring and ASD start-up is complete and all safeties are verified.

f. Automatic temperature-control systems are operational.

g. Ceilings are installed.

h. Windows and doors are installed.

i. Suitable access to balancing devices and equipment is provided.

j. Equipment and duct access doors are securely closed.

2. Hydronics:

a. Piping is complete with all terminals installed.

b. Water treatment is complete.

c. Systems are flushed, filled and air purged.

d. Strainers are pulled and cleaned.

e. Control valves are functioning per the sequence of operation.

f. All shutoff and balance valves have been verified to be 100% open.

g. Pumps are started and proper rotation is verified.

h. Pump gauge connections are installed directly at the pump inlet and outlet flange or in discharge and suction pipe prior to any valves or strainers.

i. Permanent electrical power wiring and ASD start-up is complete and all safeties are verified.

j. Suitable access to balancing devices and equipment is provided.

D. Examine construction and notify Owner's Representative and Engineer of outstanding issues related to balancing, as part of "Examination Report" submittal.

1. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas.

2. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and controls are ready for operation.

3. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected, configured by the controls contractor and functioning.

4. Examine strainers to verify that Mechanical Contractor has replaced startup screens with permanent screens and that all strainers have been cleaned.

5. Examine two-way valves for proper installation and function.

6. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

7. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

8. Examine air vents to verify that mechanical contractor has removed all air from all hydronic systems.

9. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, weld-o-lets, and manual volume dampers prior to pressure testing. Note the locations of devices that are not accessible for testing and balancing.

3.2 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.3 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 outside-air louvers and dampers and the return and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and function.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.4 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.

4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

5. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to sheaves sizes, motor sizes, and electrical connections to accommodate fan-speed changes.

6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.5 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 maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and 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 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 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 as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the conditions but leave outlets balanced for maximum airflow.

6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets 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 the adequate static pressure is maintained at the most critical unit.

8. Record the final fan performance data.

C. 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 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 outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils and heat exchangers. Obtain approved submittals and any manufacturer-recommended testing procedures. Cross check the summation of required coil and heat exchanger gpms with pump design flow rate.

B. Verify that hydronic systems are ready for testing and balancing:

1. Check liquid level in expansion tank and verify that tank is set to specified pressure for system fill and expansion.

2. Check that makeup water has adequate pressure to highest vent.

3. Check that control valves are in their proper positions.

4. Check that air has been purged from the system.

5. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

6. Verify that motor starters are equipped with properly sized thermal protection.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow through coils.

b. Measure flow by main flow meter, if installed.

c. If main flow meter is not installed, determine flow by pump total dynamic head (TDH) or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves or fittings.

b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.

c. Convert pressure to head and correct for differences in gauge heights.

d. On single stage centrifugal pumps, verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

e. With all valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.

2. Adjust main and branch balance valves for design flow.

3. Re-measure each main and branch after all have been adjusted if requested by Engineer.

C. Adjust flow measuring devices installed at terminals for each space to design water flows.

1. Measure flow at all terminals.

2. Adjust each terminal to design flow.

3. Re-measure each terminal after all have been adjusted, if requested by Engineer.

4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.

5. Perform temperature tests after all flows have been balanced, if requested by Engineer.

D. For systems with pressure-independent valves at the terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.

2. Perform temperature tests after all flows have been verified.

E. For systems without pressure-independent valves or flow measuring devices at the terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.

2. If balanced by coil pressure drop, perform temperature tests after all flows have been verified, if requested by Engineer.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.

2. Re-measure all final pump operating data, TDH, volts, amps, static profile.

3. Mark all final settings.

G. Verify that all memory stops have been set.

3.8 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

A. Measure, adjust and record the airflow of each kitchen hood. For kitchen hoods designed with integral make-up air, measure and adjust the exhaust and make-up airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.

1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.

2. Recommend means to adjust airflow to achieve design values where exhaust fans serve multiple hoods.

3. Installing contractor shall provide recommendations as required by Engineer.

B. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.

1. Check duct slopes as required.

2. Verify that duct access is installed as required.

3. Perform a light test or an approved equivalent test method to determine that all welded and brazed joints are liquid tight. Test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of ductwork to be tested. The lamp shall be open as to emit light equally in all directions perpendicular to duct walls. Test every joint in the entire duct system, including the hood-to-duct connection. Ductwork may be tested in sections provided that every joint is tested.

4. Verify that point of termination is as required.

5. Verify that duct air velocity is within the range required.

6. Prior to concealment of any portion of the grease-duct system, perform a duct leakage test in the presence of the code official.

7. Verify that duct is within a fire-rated enclosure.

C. After balancing is complete, do the following:

1. Measure and record the static pressure at the hood exhaust-duct connection.

2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 in. between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.

3. Field test the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results. The field test shall be conducted with all appliances under the hood at operating temperatures, with all sources of outdoor air providing make-up air for the hood operating, and with all sources of recirculated air providing conditioning for the space in which the hood is located operating.

D. Report deficiencies.

3.9 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans: Zero to plus 10 percent.

2. Air Outlets and Inlets: Plus or minus 10 percent.

3. Minimum Outside Air: Zero to plus 10 percent.

4. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

5. Heating-Water Flow Rate: Plus or minus 10 percent.

6. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.10 FINAL TEST AND BALANCE REPORT

A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the Testing and Balancing process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the technicians or Test and Balance Engineers.

B. The report must be organized by systems and shall include the following information as a minimum:

1. Title Page:

a. AABC or NEBB Certified Company Name.

b. Company Address.

c. Company Telephone Number.

d. Project Identification Number.

e. Location.

f. Project Architect.

g. Project Engineer.

h. Project Contractor.

i. Project Number.

j. Date of Report.

k. Certification Statement.

l. Name, Signature, and Certification Number.

2. Table of Contents.

3. National Performance Guaranty.

4. Report Summary:

a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.

5. Instrument List:

a. Type
b. Manufacturer
c. Model
d. Serial Number
e. Calibration Date

C. Required air side data - Test, adjust and record the following:

1. Motors:

a. RPM
b. BHP
c. Full load amps
d. Sheave sizes, number and size of belts
e. Shaft diameter
f. Complete nameplate data

2. Fans:

a. Cfm
b. RPM
c. Suction static pressure
d. Discharge static pressure
e. Sheave sizes, number and size of belts, key sizes, shaft, diameter
f. Complete nameplate data
g. Sketch of system's inlet and outlet connections
h. Location of test port

3. Duct: Traverse Zones:

    a. Cfm
    b. Static Pressure

4. AHU - Fan coil units, heat pumps, unit ventilators (In both minimum O.A. and economizer modes):

    a. Minimum outdoor air Cfm
    b. Total discharge and return Cfm
    c. Static profile thru unit
    d. Complete nameplate data

5. Coil:

    a. Entering air temperature (DB/WB)
    b. Leaving air temperature (DB/WB)
    c. Static differential
    d. Face velocity and area
    e. Cfm
    f. Complete nameplate data

6. Registers/Grilles/Diffusers:

    a. Cfm
    b. Set, adjust and record air flow pattern

7. Filter Banks:

    a. Nameplate data
    b. Static pressure drop

D. Required Fluid Data: Test, adjust and record the following:

1. Heat Transfer Devices: Including, but not limited to air handlers, convectors, fin tube radiation sections, unit ventilators, fan coils, cabinet heaters, unit heaters, heat pumps, heat exchangers.

    a. GPM (coil and bypass)
    b. Entering water temperature
    c. Leaving water temperature
    d. Water pressure drop
    e. Complete nameplate data
    f. Refrigerant suction pressure and temperature

2. Pumps:

    a. Check rotation
    b. GPM
    c. Pump off pressures (suction and discharge)
    d. Running suction pressure

e. Running discharge pressure
f. Running load amps
g. RPM - motor
h. Complete nameplate motor and pump
i. Marked up pump curve illustrating final operating conditions

3. Boilers:

a. GPM
b. Entering water temperature and pressure
c. Leaving water temperature and pressure
d. Complete nameplate data

4. Heat Exchanger:

a. GPM
b. Entering water temperature and pressure
c. Leaving water temperature and pressure
d. Complete nameplate data

5. Chillers - (Evaporator and Condensing Sections):

a. GPM
b. Entering water temperature and pressure
c. Leaving water temperature and pressure
d. Complete nameplate data

E. The final test and balance report shall be provided as a formal project submittal for review by the Engineer of Record.

END OF SECTION

SECTION 230710 - INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUBMITTAL

A. Submit product data, product description, manufacturer's installation instructions, types and recommended thicknesses for each application, and location of materials.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230533 - Electric Heat Tracing for HVAC Piping.

B. Section 230710.50 - Removable Insulation Blankets.

C. Section 232010 - Piping Systems and Accessories.

D. Section 233100 - Sheet Metal and Ductwork Accessories Construction.

PART 2 - PRODUCTS

2.1 GENERAL

A. Insulation, jackets, adhesive, and coatings shall comply with the following:

1. Treatment of jackets or facing for flame and smoke safety must be permanent. Water-soluble treatments not permitted.

2. Insulation, including finishes and adhesives on the exterior surfaces of ducts, pipes, and equipment, shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84.

3. Asbestos or asbestos bearing materials are prohibited.

4. Comply with 2020 Energy Conservation Construction Code of New York State.

5. All adhesives, coatings and sealants used for insulation in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits as called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

6. Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least two (2) years prior to bid opening. Provide insulation systems in accordance with the approved MICA or NAIMA Insulation Standards.

7. Insulation shall be clearly marked with manufacturer's name, identification of installed thermal resistance (R) value, out-of-package R value, flame spread and smoke developed indexes in accordance with Energy Code requirements.

2.2 ACCEPTABLE MANUFACTURERS

A. Fiberglass: Knauf/Manson, Johns Manville, Owen-Corning, Certainteed. (Board, Blanket and Liner)

B. Polyisocyanurate: Dow Trymer 2000XP, HyTherm.

C. Calcium Silicate: Industrial Insulation Group (ILG).

D. Flexible Elastomeric: Armacell, K-Flex.

E. Adhesives, Coatings, Mastics, Sealants: Childers, Foster.

2.3 PIPE INSULATION (RIGID FIBERGLASS TYPE)

A. Product meeting ASTM C 547, ASTM C 585, and ASTM C 795; rigid, molded, noncombustible.

B. 'K' Value: ASTM C 335, 0.23 at 75°F mean temperature installed value. Maximum Service Temperature: 1000°F.

C. Vapor Retarder Jacket: ASJ/SSL conforming to ASTM C 1136 Type I, secured with self-sealing longitudinal laps and butt strips.

D. Field-Applied PVC Fitting Covers with Flexible Fiberglass Insulation: Proto Corporation 25/50 or Indoor/Outdoor, UV-resistant fittings, jacketing and accessories, white or colored. Fitting cover system consists of pre-molded, high-impact PVC materials with blanket type fiberglass wrap inserts. Blanket fiberglass wrap inserts shall have a thermal conductivity ('K') of 0.26 at 75°F mean temperature. Closures to be stainless steel tacks, matching PVC tape, or PVC adhesive per manufacturer's recommendations.

E. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in pre-forming insulation to cover valves, elbows, tees, and flanges.

2.4 PIPE INSULATION (RIGID POLYISOCYANURATE TYPE)

A. Preformed Rigid Polyisocyanurate Insulation: Cellular foam complying with ASTM C591, rigid molded, non-combustible. 2 lb./ft^3 nominal density. Maximum thermal conductivity (k) shall be 0.19 BTU-in/ft^2 hr. °F at 75°F mean temperature. Maximum Service Temperature; 300°F.

B. Vapor Retarder Jacket; Dow Saran Vapor Retarder Film and Tape.

C. Covering Jacket; White Kraft outer surface bonded to aluminum foil and reinforced with fiberglass yarn.

2.5 FLEXIBLE TYPE INSULATION

A. Flexible Elastomeric Thermal Insulation: Closed-cell, foam material. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Maximum thermal conductivity (k) shall be 0.25 BTU-in/ft^2 hr. °F at 75°F mean temperature. Adhesive: As recommended by insulation material manufacturer.

B. Insulation shall have a flame-spread index of less than 25 and a smoke-developed index of less than 50 as tested by ASTM E 84 and CAN/ULC S-102, "Method of Test for Surface Burning Characteristics of Building Materials".

2.6 CALCIUM SILICATE

A. 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.

2.7 DUCT INSULATION

A. Duct insulation shall have a thermal resistance (R) value identification mark by the manufacturer applied no less than every 10 ft., as per Energy Code requirements.

B. Flexible Fiber Glass Blanket:

1. Product meeting ASTM C 553 Types I, II and III, and ASTM C 1290; Greenguard compliant.

2. 'K' Value of 0.27 at 75°F mean temperature. Maximum Service Temperature (Faced): 250°F.

3. Vapor Retarder Jacket: FSK conforming to ASTM C 1136 Type II. Provide ASJ jacket for ductwork to be painted.

4. Installation: Maximum allowable compression is 25%. Securement: Secured in place using outward cinching staples in combination with appropriate pressure-sensitive aluminum foil tape. Coat taped seams with glass fabric and vapor barrier coating.

5. Density: 0.75 or 1.0 PCF. See Exhibit II for the thickness requirement at each density.

C. Rigid Fiber Glass Board:

1. Product meeting ASTM C 612 Type IA and IB.

2. 'K' Value of 0.23 at 75°F mean temperature. Maximum Service Temperature: 450º F.

3. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type I, or FSK or PSK conforming to ASTM C 1136 Type II. Provide ASJ jacket for ductwork to be painted.

4. Securement: Secured in place using adhesive and mechanical fasteners spaced a minimum of 12 in. on center with a minimum of 2 rows per side of duct. Insulation shall be secured with speed washers and all joints, breaks and punctures sealed with appropriate pressure-sensitive foil tape. Coat taped seams with glass fabric and vapor barrier coating.

   a. Concealed Areas: Minimum 3 lb./ft.^{3}.

   b. Exposed Areas: 6 lb./ft.^{3} minimum density for duct less than 8 ft. - 0 in. above finished floor.

D. Kitchen Hood Exhaust Duct Wrap: John Mansville Firetemp Wrap, Certainteed FlameChek, Unifrax FyreWrap or approved equal. Wrap shall be compliant with ASTM E2336 Fire Resistive Duct Enclosure System, fully tested against internal grease ducts fires (ASTM E-2336), external fires (ASTM E 119/UL263), through penetration insulated duct fires (ASTM 814/UL1479), wall fires (ASTM E 119), and surface burning (ASTM E 84/UL723). Wrap for grease duct applications shall use two layers of 1-1/2 in. wrap. The interior layer is applied with a butt joint. The second layer is offset a minimum of six inches from the initial layer. It is applied with an overlap of three inches and the insulated duct is banded with stainless steel straps.

E. Polyisocyanurate Board: Closed cell polyisocyanurate core bonded to a triple laminated foil facing on both sides. Comply with ASTM C1289 Type I Class I. "K" value: 0.17 BTU in/(hr. sq.ft. degree F) at 75 deg. F.

2.8 EQUIPMENT INSULATION

A. Rigid Fiber Glass Board:

1. Product meeting ASTM C 612 Type IA and IB.

2. Concealed Areas:

   a. Density: Minimum 3 PCF.

   b. 'K' Value of 0.23 at 75°F mean temperature. Maximum Service Temperature: 450°F.

   c. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type I, or FSK conforming to ASTM C 1136 Type II.

3. Exposed Areas:

   a. Density: Minimum 6 PCF

   b. 'K' Value: ASTM C 177, 0.22 at 75°F mean temperature.

   c. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type I, or FSK conforming to ASTM C 1136 Type II.

B. Foam Board. Polyisocyanurate core. Foil faced on one side and opposite side faced with white acrylic coated embossed aluminum, 4-mil. equal to "Dow Chemical Thermax Heavy Duty".

2.9 FIELD-APPLIED JACKETS

A. Piping:

1. PVC Pipe Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming. Adhesive: As recommended by insulation material manufacturer. PVC Jacket Color: White.

2. Aluminum Jacket: Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003-alloy, and H-14 temper. Finish and Thickness: Corrugated finish, 0.010 inch thick. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

3. Stainless-Steel Jacket: ASTM A 666, Type 304 or 316; 0.10 inch thick; and factory cut and rolled to indicated sizes. Moisture Barrier: 3-mil- thick, heat-bonded polyethylene and kraft paper. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

4. Alumaguard Jacketing: Self adhesive, 60 mil thick, rubberized bitumen, foil faced membrane. Polyguard Products, Inc. Alumaguard 60, or equal.

5. Venture Guard Jacketing: 26.6 mil thick, Hypalon self adhesive membrane. Venture Tape Corp. Venture Guard, or equal.

B. Ductwork:

1. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness and corrugation dimensions are scheduled at the end of this Section. Finish: Cross-crimp corrugated or stucco embossed finish. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.

2. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

3. Alumaguard Jacketing: Self adhesive, 60 mil thick, rubberized bitumen, foil faced membrane. Polyguard Products, Inc. Alumaguard 60, or equal.

4. Venture Guard Jacketing: 26.6 mil thick, Hypalon self adhesive membrane. Venture Tape Corp. Venture Guard, or equal. To be used on the bottom surface

of rectangular ducts greater than 24 in. wide, due to lesser jacket weight that will avoid sagging issues over time.

2.10 COATINGS, MASTICS, ADHESIVES AND SEALANTS

A. Vapor Barrier Coatings: Used in conjunction with reinforcing mesh to coat insulation on below ambient services temperatures. Permeance shall be no greater than 0.08 perms at 45 mils dry as tested by ASTM F1249. Foster 30-65 Vapor Fas; Childers CP-34, or approved equal.

B. Lagging Adhesives: Used in conjunction with canvas or glass lagging cloth to protect equipment/piping indoors. Foster 30-36 Sealfas; Childers CP-50AMV1 Chil Seal, or approved equal.

C. Weather Barrier Mastic: Used outdoors to protect above ambient insulation from weather. Foster 46-50 Weatherite; Childers CP-10 Vi Cryl, or approved equal.

D. Fiberglass Adhesive: Used bond low density fibrous insulation to metal surfaces. Shall meet ASTM C916 Type II. Foster 85-60; Childers CP-127, or approved equal.

E. Elastomeric Insulation Adhesive: Used to bond elastomeric insulation. Foster 85-75; Childers CP-82, or approved equal.

F. Elastomeric Insulation Coating: Water based coating used to protect outside of elastomeric insulation. Foster 30-65, Childers CP-34 or approved equal.

G. Insulation Joint Sealant: Used as a vapor sealant on below ambient piping with polyisocyanurate and cellular glass insulation. Foster 95-50; Childers CP-76, or approved equal.

H. Metal Jacketing Sealant: Used as a sealant on metal jacketing seams to prevent water entry. Foster 95-44; Childers CP-76, or approved equal.

I. Reinforcing Mesh: Used in conjunction with coatings/mastics to reinforce. Foster Mast A Fab; Childers Chil Glass #10, or approved equal.

2.11 MATERIALS AND SCHEDULES

A. See Exhibits at the end of this section.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes, and industry standards.

B. Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation. No glass fibers shall be exposed to the air.

C. All pipe and duct insulation shall be continuous through hangers, walls, ceiling and floor openings, and through sleeves, unless not allowed by Fire Stop System. Refer to Section 230500 "Basic Requirements" for Fire Stop Systems.

D. Provide thermal insulation on clean, dry surfaces and after piping, ductwork and equipment (as applicable) have been tested. Do not cover pipe joints with insulation until required tests are completed.

E. All cold surfaces that may "sweat" must be insulated. Vapor barrier must be maintained; insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation. Cover valves, fittings and similar items in each piping system with insulation as applied to adjoining pipe run. Extra care must be taken on piping appurtenances to insure a tight fit to the piping system. For piping systems with fluid temperatures below ambient, all vapor retarder jacket (ASJ) seams must be coated with vapor barrier coating. All associated elbows, fittings, valves, etc. must be coated with vapor barrier coating and reinforcing mesh to prevent moisture ingress. Valve extension stems require Elastomeric insulation that is tight fitting to the adjoining fiberglass system insulation. Pumps, strainers, air separators, drain valves, etc. must be totally encapsulated with Elastomeric insulation.

F. Items such as boiler manholes, handholds, clean-outs, ASME stamp, and manufacturers' nameplates, may be left un-insulated unless omitting insulation would cause a condensation problem. When such is the case, appropriate tagging shall be provided to identify the presence of these items. Provide neatly beveled edges at interruptions of insulation.

G. Provide protective insulation as required to prevent personnel injury: Piping from zero to seven feet above all floors and access platforms including hot (above 140°F) piping and any other related hot surface.

H. All pipes shall be individually insulated.

I. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site.

3.2 PIPE INSULATION

A. Insulate piping systems including fittings, valves, flanges, unions, strainers, and other attachments installed in piping system, whether exposed or concealed except within radiation enclosures.

B. Insulation installed on piping operating below ambient temperatures must have a continuous vapor retarder. All joints, seams and fittings must be sealed.

C. Hanger Shields: Refer to Section 232010 "Piping Systems and Accessories".

D. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed as required between the pipe and the insulation

shields. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required.

1. Pre-Insulated Type: Butt insulation to hanger shields and apply a wet coat of vapor barrier cement to the joints and seal with 3 in. wide vapor barrier tape.

2. Field Insulated Type: Provide Hamfab Co. "H" blocks per manufacturers recommended spacing between pipe and shield.

3. Tape shields to insulation.

E. Joints in section pipe covering made as follows:

1. All ends must be firmly butted and secured with appropriate butt-strip material. On high-temperature piping, double layering with staggered joints may be appropriate. When double layering, the inner layer should not be jacketed.

2. Standard: Longitudinal laps and butt joint sealing strips cemented with white vapor barrier coating, or factory supplied pressure sensitive adhesive lap seal.

3. Vapor Barrier: For cold services, Longitudinal laps and 4 in. vapor barrier strip at butt joints shall be sealed with white vapor barrier coating. Seal ends of pipe insulation at valves, flanges, and fittings with white vapor barrier coating. When using polyisocyanurate or cellular glass on below ambient piping/duct, seal all insulation joints with insulation joint sealant.

F. Fittings, Valves and Flanges:

1. Chilled Water: Flexiblefitting insulation of the same material and thickness as the adjacent pipe insulation. Vapor seal with two (2) coats of white vapor barrier coating.

2. Hot Services and Domestic Cold Water: Flexible insulation of the same material and thickness as the adjacent pipe insulation. Vapor seal domestic cold water with two (2) coats of white vapor barrier coating.

3. White PVC jacketing, with continuous solvent weld of all seams. Tape all fittings.

G. Flexible Pipe Insulation:

1. Split longitudinal joint and seal with adhesive.

2. Fittings made from miter-cut pieces properly sealed with adhesive, or ells may be continuous.

3. Where exposed outdoors, provide with Alumaguardjacketing.

H. For piping exposed to the elements, jacketing shall be aluminum with a factory applied moisture barrier. Fitting covers shall be of similar materials. The insulation and jacketing shall be held firmly in place with a friction type Z lock or a minimum 2 in. overlap joint.

All joints shall be sealed completely along the longitudinal seam and installed so as to shed water. All circumferential joints shall be sealed by use of preformed butt strips; minimum 2 in. wide or a minimum 2 in. overlap. Butt strips shall overlap the adjacent jacketing a minimum 1/2 in. and be completely weather sealed. Jacket at ells and tees shall be mitered, or pre-manufactured fitting jackets shall be provided, with additional aluminum holding bands, as required. All joints shall be sealed watertight using specified metal jacketing sealant as recommended by the manufacturer.

I. Apply PVC jacket where indicated, with 1 in. overlap at longitudinal seams and end joints. Seal with manufacturers recommended adhesive.

J. Apply either aluminum or PVC jacketing to exposed insulated pipe, valves, fittings, and specialties, at an elevation of 8 feet or less above finished floor in mechanical/electrical rooms, penthouses, and services aisles/pipe chases. Fittings of aluminum-jacketed piping may be either aluminum or standard PVC fitting covers.

K. All exposed piping less than 8'-0" above finished floor in occupied spaces shall be insulated with polyisocyanurate insulation (for cold services) or calcium silicate (for hot services) and rigid fiberglass fittings. All exposed piping shall have a continuous 30 mil thick white PVC jacketing.

3.3 DUCTWORK INSULATION

A. Provide external thermal insulation for duct. Not required where ducts have internal acoustical insulation. Make special provisions at dampers, damper motors, thermometers, instruments, and access doors. Apply as follows:

1. Rigid Board Type: Impale board over mechanical fasteners, welded pins or adhered clips, 12 in. to 18 in. centers; minimum of two (2) rows per side. Secure insulation with washer clips. Self-adhesive clips are not acceptable. Staple all joints. Seal breaks and joints in vapor barrier with 4 in. wide matching tape and 4 in. glass-fab applied with specified vapor barrier coating. Apply tape over corner beading where exposed.

2. Flexible Blanket Type: Install Duct Wrap to obtain specified R-value using a maximum compression of 25%. Installed R-value shall be per energy code requirements. Firmly butt all joints. The longitudinal seam of the vapor retarder must be overlapped a minimum of 2 in. Where vapor retarder performance is required, all penetrations and damage to the facing shall be repaired using pressure-sensitive foil tape, and coated with vapor barrier coating prior to system startup. Pressure-sensitive foil tapes shall be a minimum 3 in. wide and shall be applied with moving pressure using a squeegee or other appropriate sealing tool. Closure shall have a 25/50 Flame Spread/Smoke Developed Rating per UL 723. Duct wrap shall be additionally secured to the bottom of rectangular ductwork over 18 in. wide using mechanical fasteners on 18 in. centers. Self-adhesive clips are not acceptable. Care should be exercised to avoid over-compression of the insulation during installation.

3. Kitchen Hood Exhaust Duct Wrap: Install duct wrap in strict accordance with the manufacturer's written installation methods.

4. Exterior Ductwork: Finish with an aluminumjacket. All joints shall be positioned so as to shed water; with a minimum 3 in. overlap, and completely weather sealed with specified metal jacketing sealant.

3.4 EQUIPMENT INSULATION

A. Apply insulation with joints firmly butted as close as possible to the equipment surface. Insulation shall be secured as required with adhesive, mechanical fasteners or banding material. Fasteners shall be located a maximum of 3 in. from each edge and spaced no greater than 12 in. on center.

B. Vapor retarders shall overlap a minimum of 2 in. at all seams and be sealed with appropriate pressure-sensitive tape and vapor barrier coating. All penetrations, facing damage, and mechanical fasteners shall be covered with a minimum 2 in. overlap of tape and vapor barrier coating.

C. Calcium Silicate Equipment Insulation: Secure blocks with galvanized steel bands, 12 in. O.C., then point with insulating cement. Field apply 8 oz. knit fiberglass cloth, cemented and applied over standard jacket. Properly cut at fittings to avoid wrinkles and coat with white mastic coating. Leave ready for painting.

D. Fiberglass Equipment Insulation: Secure fiberglass with pins, studs, or clips. Field apply 8 oz. knit fiberglass cloth, cemented and applied over standard jacket. Properly cut at fittings to avoid wrinkles and coat with white lagging adhesive/coating. Leave ready for painting.

E. Equipment insulation exposed to the elements shall be finished with minimum 0.030 in. thick outdoor weather able PVC, specified weather barrier mastic and glass cloth, or metal. All joints shall be positioned so as to shed water; with a minimum 3 in. overlap, and completely weather sealed.

F. For equipment insulation exposed in mechanical rooms or subject to mechanical abuse, finish with minimum 0.020 in. thick PVC Jacketing or metal. All other insulation shall be finished as appropriate for the location and service or as specified on the drawings.

EXHIBIT "I" - PIPE INSULATION MATERIALS

SERVICE	INSULATION MATERIAL	THICKNESS	REMARKS
Hot water, Chilled Water, and Dual Temp Loop	Glass fiber	1-1/2 in. and Larger: 2 in. 1-1/4 in. and Smaller: 1-1/2 in.	Provide with vapor retarder jacket
Refrigeration Piping (Suction and liquid lines)	Flexible	1 in. and Larger: 1 in. 3/4 in. and Smaller: 1/2 in.	
Outdoor Refrigeration Piping (Suction and liquid lines)	Flexible	1 in. and Larger: 1 in. 3/4 in. and Smaller: 1/2 in.	Insulation shall be provided with a UV resistant coating. Cover with Alumaguard jacketing applied per manufacturer's recommendations
Concealed AC unit condensate drains	Flexible	All Sizes: 1/2 in.	
Piping in exterior walls, spaces, overhangs, attics, exterior, or where subject to freezing.		Insulate pipe with double the thickness called for above	

EXHIBIT "II" - DUCT INSULATION MATERIALS

SERVICE	INSULATION MATERIAL	THICKNESS	REMARKS
HVAC Supply	Within mechanical rooms or exposed at 8 feet or less above finished floor: Rigid fiberglass	……..……..1-1/2 in.	Min. installed R value of 6
	Concealed: Flexible fiberglass	……2 in. at 1.0 PCF or ……2.2 in. at 0.75 PCF	Min. installed R value of 6
Supply or Return ducts in cold attic spaces or other un-conditioned spaces	Flexible fiberglass	……..……..…5 in	Min. installed R value of 12
Exhaust ducts in cold attic spaces or other un-heated spaces	Flexible fiberglass	……..……. 3 in	Min. installed R value of 8
Supply ducts, exposed within the conditioned space served	…….	…NOT INSULATED…	Does not include the associated supply ductwork within the Mechanical Room or supply duct to the conditioned space.
Interior ductwork indicated to be lined	…….	…NOT INSULATED…	……
Return and exhaust ducts within heated building envelope	…….	…NOT INSULATED…	……
Outside air ducts and plenums, connections and mixing boxes	Rigid fiberglass	……..……. 2 in.	Min. installed R value of 8 Provide neat fit at intake plenum

SERVICE	INSULATION MATERIAL	THICKNESS	REMARKS
Exhaust, relief or vent ducts and plenums	Exposed: Rigid fiberglass Concealed: Flexible fiberglass	……...……1-1/2 in. ……...……2 in.	Min. installed R value of 6 Insulate 15 ft. from exterior opening and plenums
Concealed kitchen hood exhaust	UL1978 Grease duct wrap	……Two (2) Layers @ 1-1/2 in.	
Outdoor Ductwork	Polyisocyanurate board Rigid Fiberglass	……...……..2-1/2 in. ……...……..3 in.	Min. installed R value of 12 Cover with Alumaguard jacketing applied per manufacturer's recommendations. Pitch insulation to avoid ponding on top of duct.

EXHIBIT "III" - EQUIPMENT INSULATION MATERIALS

SERVICE	INSULATION MATERIAL	THICKNESS	REMARKS
Air removal assemblies and fabric filter assemblies	----------	SAME AS WATER PIPING	
Dual system expansion tanks and chemical feed tanks	----------	SAME AS WATER PIPING	----------
Dual Temp and chilled water water pumps and cold heat exchangers	Flexible sheets of Elastomeric foam	……..…. 1 in.	Arrange for easy removal. Coat with white finish.
	Polyisocyanurate	…… 1 in.	Construct a "box-style" to cover with removable access sections where required. Seal all joints with manufacturer's recommended vapor barrier.

END OF SECTION

SECTION 230923 - BUILDING MANAGEMENT SYSTEM - DDC LOGIC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services as required for the complete installation designed in Contract Drawings. Provide a complete Building Management System (BMS), to perform the functions described in this Section. All new equipment shall be compatible with the existing system. Provide wiring and conduit required to connect devices furnished as a part of, or accessory to, this automatic control system. Control wiring is defined as wiring up to and including 120 volts. Install wiring in accordance with requirements of "Electrical Wiring" in Section 230504, and the National Electrical Code. Provide all required devices for proper system operation, including special electrical switches, transformers, relays, pushbutton stations, etc.

1. All Actuation of valves and dampers shall be electric unless specifically called out elsewhere in the specifications or drawings.

B. The Mechanical Contractor shall be responsible to provide the services to develop the BMS System documentation, programming, installation of the equipment, and commissioning such that the project has a complete and workable Building Management System that is fully compliant with the requirements of this specification section.

C. The BMS System shall have the following capabilities as described in these specifications:

1. The network controllers and operator's workstations shall be connected directly to the Owner's Ethernet Network. The network controller shall also contain SNMP for integration to the Owner's Network Controllers System.

2. Off site access for Owner's personnel shall be provided and shall have full workstation capability from remote location. Identical graphical displays shall be provided for offsite access to match the displays at the on-site Operator's Workstation. Connection to the site shall be via a high speed Ethernet connection.

3. The Network Controller must act directly as the WEB server. It must directly generate the HTML code to the requesting user (i.e. WEB browser), eliminating the need and reliance on any PC-based WEB server hardware or software.

4. The system shall be capable of sending both emails and text messages, and calling landline/cell phone numbers for alarms. A minimum of six (6) email addresses and phone numbers (for text and phone call messages) must be supported by the system. Coordinate with the Owner for email addresses, phone numbers and alarms.

5. All system variables in the temperature control system shall be Microsoft variables allowing them to be displayed and manipulated in other Microsoft products.

6. Network controllers shall all be flash upgradeable and not require changing chips for upgrades.

7. Short term logging of historical data shall be provided for every DDC input and output in the system. Each point shall be capable of being logged for a minimum of two (2) weeks.

D. The BMS shall consist of PC-based workstations and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions. Further, the system shall be the backbone framework for the Security/Card Access/CCTV system through the front-end software.

E. The system shall consist of the following components:

1. Provide one (1) File Server, one (1) Operator Workstation Computer(s), and printer(s) as described in this specification. The Workstations shall be running the standard workstation software developed and tested by the manufacturer of the network controllers and the standalone controllers. No third party front-end workstation software will be acceptable.

2. Provide Ethernet-based network controllers as described in this specification. Controllers shall connect directly to the Operator Workstation over Ethernet, provide communication to the Standalone Digital Control Units and/or other Input/Output Modules and serve as a gateway to equipment furnished by others.

3. Provide the necessary quantity and types of standalone controllers to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each standalone controller shall operate completely standalone, containing all of the I/O and programs to control its associated equipment.

4. A high speed Ethernet connection to the site shall be used for offsite access to the site. Coordinate with the Owner's IT professionals for high speed system access and shall comply with Owner's requirements to maintain the level of security required by the Owner. Coordinate with Owner and provide VPN (Virtual Private Network) as required, to comply with the Owner's IT professionals requirements.

5. BACnet Protocol Integration - BACnet:

a. The neutral protocol used between systems will be BACnet over Ethernet and comply with ASHRAE BACnet standard 135-2003.

b. A complete Protocol Implementation Conformance Statement shall be provided for all BACnet system devices.

c. The ability to command share point object data, change of state data and schedules between the host and BACnet systems shall be provided.

1.2 QUALITY ASSURANCE

A. The complete automatic temperature control system shall be comprised of electric control devices with a microprocessor based Direct Digital Control System. All work shall be installed only by skilled mechanics employed by the BMS Contractor or Subcontractor.

B. The BMS Contractor/Subcontractor shall have a minimum of five (5) years experience in systems of similar size, type and complexity installed within a 100 mile radius.

C. The BMS Contractor/Subcontractor shall have a local service department (within a 50 mile radius) and have available a minimum of three (3) factory trained technicians within a 24 hour period.

D. All components shall be fully tested and documented to operate as a complete system.

E. Supplier must guarantee that all replacement parts will be carried in stock for a period of ten (10) years minimum from the date that the system is commissioned.

F. Electrical standards: Provide electrical products that comply with the following agency approvals:

1. UL 916; Energy Management Systems for Temperature Control components and ancillary equipment.

2. UL 873; Temperature Indication and Regulating Equipment.

3. FCC, Part 15, Subpart J, Class A Computing Devices.

G. All products shall be labeled with the appropriate approval markings. System installation shall comply with NFPA, NEMA, Local and National codes.

1.3 ACCEPTABLE MAKES

A. The complete Building Management System is designed and based on that manufactured by the following: Acceptable Make: Andover, Siemens Building Technologies, Siebe Environment Controls, Johnson Controls, Automated Logic, Alertron.

1.4 SUBMITTALS

A. Submit for review, a brochure containing the following:

1. Detailed piping and wiring control diagrams and systems description for each system under control.

2. Detailed layout and nameplate list for component control panels and DDC panels.

3. Submit a valve and damper schedule showing size, pressure drop configuration, capacity, and locations. Provide apparatus bulletins and data sheets for all control system components.

4. A complete listing of input and output points, control loops and/or routines, including time of day functions, and facilities management system functions for each controlled system. This listing shall include point logical names, identifiers, and alarmable ranges.

5. Provide as part of a separate submittal a hard copy of all graphics showing system components, sensor locations, setpoints and fixed/variable data. Engineer shall review and approve graphic format prior to final acceptance of system.

1.5 SCOPE OF WORK

A. Except as otherwise noted, the control system shall consist of all Ethernet Network Controllers, Standalone Digital Control Units, workstations, software, sensors, transducers, relays, valves, dampers, damper operators and other accessory equipment, along with a complete system of electrical interlocking wiring as required to fill the intent of the specification and provide for a complete and operable system.

B. The BMS Contractor/Subcontractor shall review and study all HVAC drawings and the entire specification to familiarize themselves with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.

C. All interlocking, wiring and installation of control devices associated with the equipment shall be provided under this Contract. The BMS Contractor/Subcontractor shall demonstrate the operation of the system to the Owner and prove that it complies with the intent of the drawings and specifications.

D. Provide services and manpower necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor and Owner's representative. Commissioning reports showing the testing of each DDC point on the system shall be submitted to the Engineer for review and approval upon completion of the commissioning process. Refer to the Commissioning Specification Section 019113.

1.6 WORK INCIDENTAL TO TEMPERATURE CONTROL CONTRACTOR

A. The BMS Contractor/Subcontractor shall furnish the following materials, installation by the HVAC Contractor:

1. For piping work:

a. Control valves in piping.

b. Immersion sensing wells in piping systems.

c. Valved pressure taps.

2. For sheet metal work:

a. All automatic dampers, the BMS Contractor/Subcontractor shall assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper and motors.

b. The HVAC Contractor shall provide access doors or other means of access through ducts or ceilings and walls for service and adjustment of controllers, valves, and dampers.

B. Control manufacturer shall furnish written details, instructions and supervision for the above trades to ensure proper installation size, and location of any equipment furnished for installation by others.

C. BMS Contractor/Subcontractor is responsible for providing 120 volt dedicated power to all DDC panels and operator workstations.

D. BMS Contractor/Subcontractor is responsible for providing 120 volt dedicated power and control transformers at all microprocessor based VAV terminal unit controllers laboratory control valves. As an option, provide control transformers sized to serve multiple VAV terminal unit controllers laboratory control valves. The Electrical Contractor is responsible for providing a junction box or boxes to obtain power, on a per floor basis. See electrical plans for locations.

E. BMS Contractor/Subcontractor is responsible for installing dedicated phone line for DDC system modems.

F. BMS Contractor/Subcontractor is responsible for providing Ethernet data drops at main building controller and at operator workstation.

1.7 CONTROL SYSTEM GUARANTEES

A. Guarantee the new control system to be free from defects in material and workmanship, for a period of one (1) year after final acceptance. Guarantee system to:

1. Maintain temperatures within 1°F above and below setting.

2. Humidity devices shall maintain relative humidity conditions within 3% of span 0-100% RH.

B. Provide one (1) year maintenance service of control components, to start concurrently with the guarantee specified above. Such service shall include software updates and 24 hour, 7 day emergency and seasonal inspection and adjustment of operating controls and replacement of parts or instruments found deficient and defective during this period.

C. Provide monitoring of the DDC system as soon as the system is operating and then for a minimum of one (1) year (24 hours/day, 7 days/week) after the acceptance date. A monthly report will be sent to the Owner with a description of general system status and any alarms or off-normal conditions.

D. Guarantee future availability of continuous, 24 hour, 7 day a week service for the systems through available maintenance contracts.

1.8 SYSTEM ADJUSTMENT AND CALIBRATION

A. When the Work has been completed, completely adjust and calibrate the control system. Review the operation of each system input and output, control loops and/or software routings, timing functions, operator entered constants and facilities management functions and observe that they perform their intended functions. Provide a complete values and points log, printed every hour, for one week to demonstrate control functions and programming. Provide one point log for summer operation and one winter. Points to be trended shall be selected by the Engineer. When above procedure has been completed and the control system is operating satisfactorily, submit a letter with one (1) copy of completed values and points log to the Owner's Representative advising them that the control system is 100% complete and operates in accordance with the Contract Documents.

B. After review and approval of points log by the Engineer, the BMS Contractor shall schedule a technician on site for field review of system components, operation and graphics as part of final system appearance.

1.9 INSTRUCTIONS TO THE OWNER'S REPRESENTATIVE

A. Provide competent control technicians to instruct the Owner's operating personnel and turn over three (3) copies of maintenance manual. Provide a total of 24 hours of instruction at the site, 16 hours during start-up and 8 after six (6) months. Instruction sessions shall be scheduled at the Owner's convenience and shall be limited to four (4) hours per session. The instructions shall include, but not be limited to, the following:

1. System Overview.

2. System Software and Operation:

    a. System Access.

    b. Software Features Overview.

    c. Changing Setpoints and Other Attributes.

    d. Scheduling.

    e. Editing Programmed Variables.

    f. Displaying Color Graphics.

    g. Running Reports.

    h. Workstation Maintenance.

    i. Application Programming.

3. Operational sequences including start-up, shutdown, adjusting and balancing.

4. Equipment maintenance.

PART 2 - PRODUCTS

2.1 CONTROL DEVICES

A. Control Valves:

1. Sized by BMS Contractor/Subcontractor and guaranteed to meet the heating and cooling requirements. Water valves shall be sized on the basis of 15% of the total system pressure drop, but not more than 10 ft. of head drop. Steam valves shall be sized for no more than a 5 psig pressure drop, or 30% (max.) of design steam pressure, whichever is smaller. Pressure drop for valves shall be submitted for review, including all CV values.

2. Valves shall be equal percentage type, equipped with characteristic type throttling plug, #316, stainless steel or Monel stem, removable composition discs, and rubber diaphragms. Provide with necessary features to operate in sequence with other valves or damper operators and adjustable throttling range as required by the sequence of operations.

3. Valves in 2 in. and smaller shall be screwed bodies; 2-1/2 in. and larger shall be flanged bodies; designed for 125 psi operating pressure. Arranged to fail-safe as called for; tight closing and quiet operating.

4. Electric Operators:

   a. Provide 24 VAC control operators which are 0-10 VDC input proportional with spring return as needed by control sequence and designed for water service valve bodies. Operator shall be synchronous motor driven with up to 150 in. lb. force and force sensor safety stop.

B. Temperature Sensors:

1. All temperature devices shall use precision thermistors accurate to ± 0.36°F over a range of -30 to 230°F.

2. Standard space sensors shall be provided in an off white, or white, enclosure for mounting on a standard electrical box.

3. Provide manual adjustment slider with ± programmable scale. Programmable scale shall have the capability to be limited via the DDC System.

4. Provide a local LCD display for viewing the space temperature.

5. Duct temperature sensors shall incorporate a thermistor bead embedded at the tip of a stainless steel tube. Probe style duct sensors shall be used in air handling applications where the air stream temperature is consistent and is not stratified. Averaging sensors shall be employed in all mixing plenum and coil discharge applications and in any other application where the temperature might otherwise be stratified. The averaging sensor tube shall contain at least four thermistor sensors.

6. Immersion sensors shall be employed for measurement of temperature in all chilled water, hot water and glycol applications. Thermal wells shall be brass or stainless steel for non-corrosive fluids below 250°F and 300 series stainless steel for all other applications.

C. Humidity Sensors:

1. Humidity sensors shall be polymer resistance type.

2. Duct sensors and Outdoor air humidity sensors shall have a sensing range of 5 to 95% RH with accuracy of +/ 3% RH. Sensors shall be suitable for ambient temperature conditions of -40 to 212°F.

D. Electric Thermostats:

1. Provide a low voltage thermostat for control of single zone heating and air conditioning unit as specified in the sequence of operation. Electric thermostats shall include a display of the current space temperature as well as a mechanism for adjusting the setpoint locally. Aquastats on unit heaters shall stop the fan when the water temperature is below 100°F.

E. Temperature Sensor, Humidistat Sensor or Thermostat Guards:

1. Provide heavy duty acrylic lockable guard to prevent damage and tampering.

F. Electric Operators (Damper):

1. Provide 24 VAC control operators which are 0-10 VDC input proportional or two position with spring return as needed by control sequence and designed to operate control dampers. Operator shall by synchronous motor driven with up to 150 in. lb. force sensor safety stop and return as required.

G. Control (Motorized) Dampers:

1. Provide control dampers as shown on the drawings and diagrams, to meet the following minimum construction standards.

2. Leakage: Class 1, 4 CFM/sq. ft. at 1 in. W.C., tested per AMCA Standard 500-D-98 and AMCA Standard 511 and bearing AMCA's Certified Ratings for both air performance and air leakage.

3. Frame: 16 gauge galvanized steel structural hot channel with tabbed corners for reinforcement to meet 13 gauge criteria.

4. Blades: 14 gauge (equivalent thickness galvanized steel) roll forward air foil type for low pressure drop and low noise generation. Blades shall be parallel for two-position dampers and opposed, for modulating dampers.

5. Blade Seals: Ruskiprene, suitable for -72°F to +275°F mechanically locked into the blade edge.

6. Jamb Seals: Flexible metal, compression type.

7. Blade Axles: 1/2 in. plated steel hexagonal positively locked into the damper blade. Linkage conceded out of the air stream.

8. Bearings: Corrosion resistant, permanently lubricated stainless steel sleeve.

9. Dampers subject to corrosive fumes or humidity shall be constructed of stainless steel.

10. Dampers over 48 in. length and height shall be made in multiple sections.

11. Where damper sizes are not specifically indicated, they shall be sized by the Temperature Control Contractor. Maximum velocity shall be 1500 fpm and maximum pressure drop 0.1 in. w.g.

12. Where shown or required for proof of closure or open position, provide factory installed damper positioning switch package Ruskin Model SP-100.

13. Dampers shall be as manufactured by Ruskin CD60 Control Damper, or equivalent Tamco or Greenheck.

H. Pressure Sensors:

1. Air pressure or differential air pressure measurements in the range of 0 to 10 in. water column shall be accurate to ± 1% of range using a solid-state sensing element. The range of the instrument selected shall be 2 times the operating pressure of the sensed variable. Acceptable manufacturer shall be Setra model C-264.

2. Liquid pressure or differential liquid pressure measurements shall be accurate to ± 0.25% of range using a solid-state sensing element. The range of the instrument selected shall be 2 times the operating pressure of the sensed variable. Unit shall be provided with isolation and bypass manifold for start-up and maintenance operations. Acceptable manufacturer shall be Setra Model C-230.

3. Steam pressure measurements shall be accurate to ± 0.13% of range using a solid-state sensing element. The range of the instrument selected shall be 2 times the operating pressure of the sensed variable. Unit shall be provided with isolation and bypass manifold for start-up and maintenance operations. Acceptable manufacturer shall be Setra Model C-207.

4. Room pressure sensors shall be bi-directional, bleed airflow thermistor type. Sensor assembly shall contain three (3) individually wired, hermetically sealed bead-in-glass thermistors. The operating range shall be +3,000 FPM to -3,000 FPM, and device shall have an accuracy of $\pm$2% of readings over the entire operating airflow range. Acceptable manufacturer shall be Ebtron Model GTC116-B.

I. Current Measurement Devices:

1. Measurement of three-phase power shall be accomplished with a kW/kWh transducer. The instrument shall utilize direct current transformer inputs to calculate the instantaneous value (kW) and a pulsed output proportional to the energy usage (kWh). Provide Veris Model 6000 Power Transducer or approved equal.

J. Carbon Dioxide Sensing Devices:

1. Space or outside air carbon dioxide (CO2) sensors shall be an infrared technology based detector, and shall contain an on board relay with field adjustable trip point and adjustable time delay. The sensor shall monitor CO2 over a range of 0 - 2000 PPM. Space CO2 sensors shall operate within the range of 32-122°F and 0-95% RH. Outside air CO2 sensors shall have an operation range of -40° to 122°F and 0-95% RH. The sensor shall have an accuracy of no more than 50 PPM in the expected range of measurement, and a drift of no more 20 ppm. The sensors shall be self-calibrating. Provide an LCD display for displaying PPM level and field adjustable settings. Greystone Product # CDD4 Series, Honeywell C7232, Siemens QPA20, GE Ventostat.

K. Combination CO_2, RH, Temperature Sensors

1. Provide BACnet combination CO2/RH/Temperature measuring devices for mounting where indicated on the plans.

2. Each BACnet combination sensor shall consist of an integrated system of three or more environment sensing functions in a wall mounted package, with an integral microprocessor-based design capable of operating at least two (2) independent sensor nodes per measurement location.

3. BACnet combination sensors shall have an environmental operating range of no less than 32 – 122° F (0 – 50° C) and 0 – 95% RH, non-condensing.

4. CO_2 Sensor Design and Performance:

a. CO_2 measurement shall be accomplished with Non-Dispersive Infrared (NDIR) technology using gold plated optics and diffusion sampling.

b. CO_2 measurement uncertainty shall be no greater than ±75 ppm (or ±7% of Reading <500 ppm and ±7.5% for 800 – 1,200 ppm) at 77° F (25° C) for a CO_2 measurement range of at least 400 – 2,000 ppm.

c. CO_2 measurement stability shall be <2% FS over the expected 15 year life of the typical sensor.

d. Each CO_2 sensor node shall be factory calibrated, shall automatically self-calibrate during operation and shall not require routine recalibration throughout its normal service life.

5. Relative Humidity (RH) Sensor Design and Performance:

   a. Each RH sensor node shall measure ambient RH using planar laminated, electrolytic polymer capacitor technology.

   b. RH measurement range shall be 0 – 100% RH, non-condensing.

   c. RH measurement accuracy shall be ±2% from 20% – 80%RH at 77° F (25° C). Outside of this normal RH operating range, accuracy shall be ±3%.

   d. RH output resolution shall be at least 0.4% of Reading.

6. Temperature Sensor Design and Performance:

   a. Each temperature sensor node shall sense changes using integral bandgap voltage reference circuitry and perfectly proportional to absolute temperature (PTAT) ΔV technology.

   b. Temperature measurement accuracy shall be equal to or greater than ±1.08° F at 77° F (±0.6° C at 25° C).

   c. The operating temperature range shall be at least -58° F to 302° F (-50° C to 150° C).

   d. Output resolution shall be at least 0.36° F (0.2° C).

7. Power, Connectivity and Communications:

   a. The BACnet combination sensor shall be capable of communicating with other devices using an RS-485 standard interface and BACnet-MS/TP protocol, implemented as a Master.

      1) Communication speed shall be field-selectable between 9.6, 19.2, 38.4 and 76.8 kBaud.

   b. BACnet devices shall implement the open protocol in compliance of the requirements of ASHRAE Standard 135-2008 and all BACnet products shall be BTL Listed.

   c. The BACnet combination sensor shall be capable of field set-up and configuration using a simple dip-switch interface.

   d. The BACnet combination sensor shall operate on 24 VAC (22.8 to 26.4 VAC), 50/60Hz.

      1) The combination sensor design shall include protection from over voltage, over current transients and power surges.

2) The combination sensor shall use "watch-dog" circuitry to assure automatic processor reset after power disruption, transients and brown-outs.

e. The BACnet combination sensor design shall be capable of communicating to the network if one of the sensor functions becomes faulty, and will continue to operate the remaining CO_2 or RH/Temp sensor nodes.

8. The BACnet combination sensor enclosure shall be a low profile wall mount type, compatible in size for mounting with a standard single-gang electrical box or for surface mount applications.

a. The sensors shall be installed at locations that are protected from weather and/or water.

9. The manufacturer's authorized representative shall review and approve wall-position placement for each measurement location indicated on the plans.

a. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer's recommendations or requirements.

10. Acceptable manufacturer shall be Ebtron Model IAQ-300-N.

L. Airflow Stations (Thermal Dispersion Type):

1. Provide thermal dispersion airflow/temperature measurement device (ATMD) at each location indicated in specifications and control sequences.

a. Fan inlet measurement devices shall not be used unless indicated on drawings or schedules.

b. Each ATMD shall consist of one to four sensor probes and a single, remote transmitter. Each sensor probe shall consist of one to eight independent sensor nodes in a gold anodized, aluminum 6063 alloy tube with 304 stainless steel mounting brackets.

c. Each sensor node shall consist of two hermetically sealed bead-in-glass thermistors. Chip thermistors of any type or packaging are not acceptable.

d. Sensor Density Requirements:

1) Sensor density (#/area) affects minimum installed distances required from disturbance types. Published sensor density data by the product manufacturer shall be submitted for approval. Sensor density shall be as follows:

Duct or Plenum Area (ft^2)	Total # Nodes / Location	Duct or Plenum Area (m^2)
<= 1	1 or 2	<= 0.093
>1 to <4	4	>0.093 to < 0.372
4 to < 8	6	0.372 to < 0.743
8 to < 12	8	0.743 to < 1.115
12 to <16	12	1.115 to < 1.486
>=16	16	>= 1.486

2) The number of individual sensor nodes for each rectangular location shall be maximized for performance within the placement conditions provided. In no instance shall field selected locations provide less distance between disturbances than required for maximum performance. When minimum distances allowed by the highest density of sensor distribution are exceeded, a lower density configuration that provides the same performance is acceptable.

3) Submittal documents shall include schedules indicating the number of sensors per location, the duct area and the equivalent density (#/area) for approval.

e. Each sensing node shall be individually wind tunnel calibrated at 16 points to NIST traceable airflow standards.

f. Each sensing node shall be individually calibrated in constant temperature oil baths at 3 points to NIST traceable temperature standards.

2. Measurement Performance:

a. Each sensing node shall have a temperature accuracy of ± 0.14°F (0.08°C) over the entire operating temperature range of -20°F to 160°F (-28.9°C to 71°C).

b. Each sensing node shall have an airflow accuracy of ± 2% of reading.

c. The ATMD shall be capable of measuring airflow rates over the full range of 0 to 5,000 FPM (25.4 m/s) between -20°F to 160°F (-28.9°C to 71°C).

d. A 3 year warranty shall be provided for the entire system.

3. Integral Transmitter and Communications:

   a. The transmitter shall be powered by 24 VAC, be over-voltage and over-current protected, and have a watchdog circuit to provide continuous operation after power failures and/or brown-outs.

   b. The transmitter shall determine the airflow rate and temperature of each sensing node prior to averaging.

   c. The transmitter shall have two isolated and fused analog output signals and one RS-485 network connection.

   d. Each analog output shall be field configurable as linear 0-5/1-5 VDC, 0-10/2-10 VDC or 4-20mA signals.

   e. One analog output signal shall provide the average airflow rate.

   f. One analog output signal shall be field configurable to output the average temperature, the velocity weighted temperature or a binary airflow alarm.

4. Listings and Certifications:

   a. The ATMD shall be UL 973 listed.

   b. The ATMD shall be BTL listed.

   c. The ATMD shall carry CE Mark for European shipments indicating successful satisfaction of all requirements contained in the EMC Directives, or when otherwise required in the destination country.

5. Design Equipment: Ebtron Model GTC116, HTA-104.

6. Make: Ebtron, Kurz, Sierra.

M. Liquid Flow Measurement:

1. Hi Liquid flow measurement devices shall be accurate to ± 0.75% over a turn down ratio of 10:1. Insertion probe sensing element shall be made of 316l stainless steel. The sensing element shall have an elliptical shape that eliminates the separation point at a fixed or variable location ahead of the static pressure pick up point. Device shall only require one welded insert to mount to piping system. Acceptable manufacturer shall be Preso, model BAR.

N. Safety/Status Devices:

1. Low Limit Detector: Electric type, with 20 ft. long serpentine element, with manual reset and auxiliary contacts to the DDC, set for 37°F for "freeze" protection and 55°F for fan discharge application. Provide a 20 ft. long element for every 25 sq. ft. of coil face area.

2. High Limit Detector: High limit thermostats shall be located as directed, and shall be manual reset type set at 120°F in the return and 180°F in the discharge. Thermostats shall be double pole so as to provide input capability for alarm at the temperature control system.

3. Pump status shall be provided through adjustable range current sensing element on pump motor.

4. Fan status shall be provided through adjustable range current sensing element on the fan motor.

O. Miscellaneous Devices:

1. Provide necessary, relays, transformers, required for a complete and operable system.

2.2 CONTROL CABINETS

A. BMS control panels shall be fully enclosed cabinet, baked enamel, steel, aluminum or composite material construction and shall meet the requirements of NEMA 1 enclosures. Panels shall have hinged door with a locking latch. Cover exposed electrical connections. Each component on front panel shall have an appropriate engraved label describing its function. Components inside the panel shall be appropriately labeled for ease of identification. Stick-on labels are not acceptable. Panels shall be either free-standing or wall-mounted. Provide support steel framing.

2.3 BUILDING MANAGEMENT SYSTEM

A. The BMS system shall consist of Network Controllers, standalone or application specific controllers, input/output unit modules, operator workstations, and file servers to support system configurations. The BMS system shall provide control, alarm detection, scheduling, reporting and information management for the entire facility.

B. The BMS shall be capable of being segmented, through software, into multiple local area networks per floor of building, distributed over a wide area network or sharing a single file server. This enables workstations to manage wide area network, and/or the entire system with all devices being updated and sharing the most current database. In the case of a single workstation system, the workstation shall contain the entire database - with no need for a separate file server.

C. For multi-workstation systems, a file server shall be utilized capable of residing directly on the Owner's Ethernet TCP/IP preferred network with no required gateways. This network may be dedicated for temperature control systems only so it does not interfere with other networks.

D. In addition to the above local area network and wide area network, the workstation software shall be capable of managing remote systems via remote high speed network as a standard component of the software.

E. The BMS system shall be scalable and expandable at all levels of the system using the same software interface and controllers.

1. The system shall use the same application programming language for all equipment: Operator Workstation, Network Controllers, Remote Site Controllers and Standalone, or application specific, Digital Controllers.

F. The BMS system design shall include solutions for the integration of the following "open systems" protocols: BACnet, LonTalk and digital data communication to third party microprocessors such as chiller controllers, fire panels and variable frequency drives (VFD's).

1. The system shall also provide the ability to program custom ASCII communication drivers, which shall reside in the network control unit, for communication to third party systems and devices. These drivers shall provide real time monitoring and control of the third party systems.

2.4 NETWORK CONTROLLERS

A. Network Controllers shall be microprocessor based, multi-tasking, multi-user, and employ a real time operating system. Each Network Controller panel shall consist of modular hardware including power supply, CPU board, and input/output modules. A sufficient number of Network Controllers shall be supplied to fully meet the requirements of this specification and the point list on the drawings.

B. All Network Controllers on the Ethernet TCP/IP LAN/WAN shall be capable, out-of-the box, to be set up as a Web Server. The Network Controllers shall have the ability to store HTML code and "serve" pages to a web browser. This provides the ability for any computing device utilizing a TCP/IP Ethernet connection and capable of running a standard Internet browser (Microsoft Internet Explorer, Netscape Navigator, etc.) to access real-time data from the entire Temperature Control System via any Network Controllers.

1. Graphics and text-based web pages shall be constructed using standard HTML code. The interface shall allow the user to choose any of the standard text or graphics-based HTML editors for page creation. It shall also allow the operator to generate custom graphical pages and forms.

2. The WEB server interface shall be capable of password security, including validation of the requesting PC's IP address. The WEB server interface shall allow the sharing of data or information between any controller or process or network interface (BACnet, LonTalk and TCP/IP) that the Temperature Control System has knowledge of, regardless of where the point is connected on the Temperature Control System network or where it is acquired from.

3. The network controller shall act directly as the WEB server. It shall directly generate HTML code to the requesting user (i.e. WEB browser), eliminating the need for and reliance on any PC-based WEB server hardware or software. To simplify graphic image space allocation, HTML graphic images, if desired, shall be stored in any shared network device. The Web server shall have the ability to

acquire any necessary graphics using standard pathing syntax within the HTML code mounted within the Temperature Control System WEB server. External WEB server hardware and software are not acceptable.

C. Hardware Specifications:

1. A minimum of 4MB of RAM shall be provided for Network Controllers with expansion up to 8MB.

2. Each Network Controller shall provide communication to both the Workstation(s) and the field buses. In addition, each Network Controller shall have at least three other communications ports that support a telephone modem, portable service tool, serial printer and connection to third party controllers such as a chiller control panel. On a LAN/WAN system, the Network Controller shall be provided with a 10Mbps plug-in Ethernet TCP/IP network interface card (NIC).

3. Input/Output (I/O): Each Network Controller shall support the addition of the following types of inputs and outputs:

   a. Digital Inputs for status/alarm contacts.

   b. Counter Inputs for summing pulses from meters.

   c. Thermistor inputs for measuring temperatures in space, ducts and thermowells.

   d. Analog inputs for pressure, humidity, flow and position measurements.

   e. Digital Outputs for on/off equipment control.

   f. Analog Outputs for valve and damper position control, and capacity control of primary equipment.

4. The system shall employ a modular I/O design to allow easy expansion. Input and output capacity is to be provided through plug-in modules of various types or DIN-mountable IOU modules. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.

5. Each Network Controller shall include a battery-backed, real time clock, accurate to 10 seconds per day. The Real Time Clock shall provide the following: time of day, day, month, year, and day of week. In normal operation, the system clock shall be based on the frequency of the AC power. The system shall automatically correct for daylight savings time and leap years.

6. The power supply for the Network Controllers shall be auto sensing, 120-220VAC, 60/50 Hz power, with a tolerance of ±20%. Line voltage below the operating range of the system shall be considered outages. The controller shall contain over voltage surge protection, and require no additional AC power signal

conditioning. Optionally, if indicated on the drawings, the power supply shall accept an input voltage of (-48 VDC).

7. Upon restoration of power after an outage, the Network Controller shall automatically and without human intervention: Update all monitored functions; resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

8. Each Network Controller with the standard 120-220VAC power supply shall include a programmable DC power backup system rated for a minimum of 72 hours of battery backup to maintain all volatile memory or, a minimum of two (2) hours of full UPS including modem power. This power backup system shall be configurable such that at the end of a settable timeframe of running on full UPS, the unit shall shut off full UPS and switch to memory retention-only mode for the remainder of the battery power. The system shall allow the simple addition of more batteries to extend the above minimum battery backup times.

D. Software:

1. The Network Controller shall contain flash ROM as the resident operating system. Application software shall be RAM resident. Application software shall only be limited by the amount of RAM memory. There shall be no restrictions placed on the type of application programs in the system. Each Network Controller shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage.

2. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be English language-based and programmable by the user. The language shall be structured to allow for the easy configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, passwords, and histories. The language shall be self-documenting. Users shall be able to place comments anywhere in the body of a program. Program listings shall be configurable by the user in logical groupings.

E. Control Software:

1. The Network Controller shall have the ability to perform the following pre-tested control algorithms:

a. Proportional, Integral plus Derivative Control (PID).

b. Two Position Control.

c. Digital Filter.

d. Ratio Calculator.

e. Equipment Cycling Protection.

2. Mathematical Functions: Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These shall be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

3. Energy Management Applications: Network Controllers shall have the ability to perform any or all of the following energy management routines:

a. Time of Day Scheduling
b. Calendar Based Scheduling
c. Holiday Scheduling
d. Temporary Schedule Overrides
e. Optimal Start
f. Optimal Stop
g. Night Setback Control
h. Enthalpy Switchover (Economizer)
i. Peak Demand Limiting
j. Temperature Compensated Duty Cycling
k. CFM Tracking
l. Heating/Cooling Interlock
m. Hot/Cold Deck Reset
n. Free Cooling
o. Hot Water Reset
p. Chilled Water Reset
q. Condenser Water Reset
r. Chiller Sequencing
s. Static Pressure Reset/Optimizing
t. Demand Controlled Ventilation
u. Supply Air Temperature Reset

4. Each controller shall be capable of logging any system variable over user defined time intervals ranging from 1 second to 1440 minutes. Any system variables (inputs, outputs, math calculations, flags, etc.) can be logged in history. A maximum of 25,000 values can be stored in each log. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logs can be automatic or manual. Logged data shall be downloadable to the Operator Workstation for long term archiving based upon user-defined time intervals, or manual command.

5. Alarm Management: For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms shall be tested each scan of the Network Controller and can result in the display of one or more alarm messages or reports.

a. Up to eight (8) alarms can be configured for each point in the controller.

b. Messages and reports can be sent to a local terminal, to the front-end workstation(s), or via modem to a remote-computing device.

c. Alarms shall be generated based on their priority. A minimum of 255 priority levels shall be provided.

d. If communication with the Operator Workstation is temporarily interrupted, the alarm shall be buffered in the Network Controller. When communications return, the alarm shall be transmitted to the Operator Workstation if the point is still in the alarm condition.

6. The Network Controller shall be able to generate user-definable reports to a locally connected printer or terminal. The reports shall contain any combination of text and system variables. Report templates shall be able to be created by users in a word processing environment. Reports can be displayed based on any logical condition or through a user command.

2.5 STANDALONE CONTROLLERS

A. Standalone Controllers shall provide control of HVAC and lighting. Each controller shall have its own control programs and shall continue to operate in the event of a failure or communication loss to its associated Network Controllers.

B. Standalone Controllers programs shall be stored in battery backed-up RAM and EPROM. Each controller shall have a minimum of 32K bytes of user RAM memory and 128K bytes of EPROM.

C. Standalone Controllers shall provide a communication port to the field bus. In addition, a port shall be provided for connection of a portable service tool to support local commissioning and parameter changes with or without the Network Controllers online. It shall be possible from a service port on any Standalone Controller to view, enable/disable, and modify values of any point or program on any controller on the local field bus, any Network Controller or any Standalone Controller on a different field bus.

D. Support BACnet standard MS/TP bus protocol ASHRAE SS PC-15, Clause 9 on the control network.

E. Each Standalone Controller shall support the addition of the following types of inputs and outputs:

1. Digital Inputs for status/alarm contacts.

2. Counter Inputs for summing pulses from meters.

3. Thermistor Inputs for measuring temperatures in space, ducts and thermowells.

4. Analog inputs for pressure, humidity, flow and position measurements.

5. Digital Outputs for on/off equipment control.

6. Analog Outputs for valve and damper position control, and capacity control of primary equipment.

F. Input and output capacity shall be expandable through the use of plug-in modules. A minimum of two (2) modules shall be added to the base Standalone Controller before additional power is required.

G. Each Standalone Controller shall be able to exchange information on a peer to peer basis with other Standalone Controllers during each field bus scan. Each Standalone Controller shall be capable of storing and referencing global variables (on the LAN) with or without any workstations online. Each Standalone Controller shall be able to have its program viewed and/or enabled/disabled either locally through a portable service tool or through a workstation connected to a Network Controller.

H. Standalone Controllers shall have as a minimum, LED indication of CPU status, and field bus status.

I. Standalone Controllers shall have a real time clock in either hardware or software. The accuracy shall be within 10 seconds per day. The Real Time Clock shall provide the following information: time of day, day, month, year, and day of week. Each Standalone Controller shall receive a signal over the network from the Network Controllers, which synchronizes all Standalone Controllers real time clocks.

J. Upon restoration of power, the Standalone Controller shall automatically and without human intervention, update all monitored functions, resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

K. Each Standalone Controller shall have at least three (3) years of battery back up to maintain all volatile memory.

L. For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms shall be tested each scan of the Standalone Controllers and can result in the display of one or more alarm messages or reports.

1. Up to eight (8) alarms can be configured for each point in the controller enabling the escalation of the alarm priority (urgency) based upon which alarm(s) is/are triggered.

2. Alarm messages can be sent to a local terminal or modem connected to a Network Controller or to the Operator's Workstation(s).

3. Alarms shall be generated based on their priority. A minimum of 255 priority levels shall be provided.

4. If communication with the Network Controller is temporarily interrupted, the alarm shall be saved in the Standalone Controller. When communications return, the alarm shall be transmitted to the Network Controller if the point is still in the alarm condition.

M. Air Handler Controllers shall be capable of meeting the requirements of the sequence of operation intended for each system and allow for future expansion.

1. Air Handling Unit Controllers shall support all the necessary point inputs and outputs as required by the sequence and operate in a standalone fashion.

2. Air Handling Unit Controllers shall be fully user programmable to allow for modification of the application software.

3. An LCD display shall be optionally available for readout of point values and to allow operators to change setpoints and system parameters.

4. A manual override switch shall be provided for all digital and analog outputs on the Air Handling Unit Controller. The position of the switch shall be monitored in software and available for operator displays and alarm notification.

N. Air Terminal Unit Controllers:

1. Air Terminal Unit Controllers shall support, but not be limited to the control of the following configurations of Air Terminal Units to address current requirements as described in the Execution portion of this specification, and for future expansion:

   a. Single Duct Cooling Only
   b. Single Duct Cooling with Reheat (Electric or Hot Water)
   c. Fan Powered (Parallel or Series)
   d. Dual Duct (Constant or Variable Volume)
   e. Supply/Exhaust

2. Air Terminal Unit Controllers for single duct applications shall be provided with a built-in actuator for modulation of the air damper. The actuator shall have a minimum torque rating of 35 in.-lb., and contain an override mechanism for manual positioning of the damper during startup and service.

3. Air Terminal Unit Controllers shall contain an integral velocity sensor accurate to ±5% of the full range of the box's CFM rating.

4. Each controller shall perform the sequence of operation described in Part 3 of this specification, and have the capability for time of day scheduling, occupancy mode control, after hours operation, lighting control, alarming, and trending.

5. Air Terminal Unit Controllers shall be able to communicate with any other Standalone Controllers on the same field bus with or without communication to the Network Controllers managing the field bus. Systems that fail to provide this (true peer-to-peer) capability will be limited to a maximum of 32 Air Terminal Unit Controllers per field bus.

O. Unitary Controllers:

1. Unitary Controllers shall support, but not be limited to, the control of the following systems as described in the Execution portion of this specification, and for future expansion:

   a. Unit Ventilators
   b. Heat Pumps (Air to Air, Water to Water)
   c. Packaged Rooftops
   d. Fan Coils (2 or 4 Pipe)

2. The I/O of each Unitary Controller shall contain the sufficient quantity and types as required to meet the sequence of operation found in the Execution portion of this specification. In addition, each controller shall have the capability for time of day scheduling, occupancy mode control, after hour operation, lighting control, alarming, and trending.

P. Lighting controllers shall provide direct control of20 amp, 120 VAC lighting circuits using mechanically held, latching relays. Controllers shall contain from 8 to 48 circuits per enclosure. Each controller shall also contain inputs for direct connection to light switches and motion detectors.

1. Each controller shall have the capability for time of day scheduling, occupancy mode control, after hour operation, alarming, and trending.

2.6 OPERATOR HARDWARE

A. The BMS workstation software shall be configurable as either a single workstation system (with a local database) or multi-workstation system where the database is located on a central file server. The client software on multi-workstation system shall access the file server database program via an Ethernet TCP/IP network running at either 100MBPS or 1024MBPS.

1. All Workstations shall be Intel Core Processor based personal computers operating under the Microsoft Windows Server 2012 R2. The application software shall be capable of communication to all Network Controllers and Standalone Controllers, feature high-resolution color graphics, alarming, reporting, and be user configurable for all data collection and data presentation functions.

2. For multi-workstation systems, a minimum of 256 workstations shall be allowed on the Ethernet network along with the central file server. In this client/server configuration, any changes or additions made from one workstation shall automatically appear on all other workstations without the requirement for manual copying of files. Multi-workstation systems with no central database will not be acceptable. Multi-workstation systems with distributed/tiered file servers and a central (master) database will be acceptable.

B. File Server Requirements. The file server shall consist of the following:

1. Base Unit: 2.53GHZ/4-core/80W/8MB Xeon processor.
2. Memory: 8 GB, 1 x 8GB PC3-10600 registered dual rank x 4.
3. Hard Drives: (3) @ TB 3G SATA, 10K Hot Plug 3.5.
4. Optical Drive: Half-height SATA DVD- RW Optical Drive.
5. Network Controller: NCZ82T PC Express dual port multifunction gigabit server adapter.
6. 18.5 in. diagonal widescreen thin film transistor LCD active matrix, resolution 1366 x 768.
7. PCI Graphics Adapter w/8Mb RAM.
8. Provide server grade keyboard and mouse.
9. Software: Microsoft Windows 2012 R2.
10. HP ProLiant ML350 Series, or equal.

C. Workstation Requirements: The workstation shall consist of the following:

1. Base Unit: 3.33 GHz, 1.5 MB, L2 + 12 MD Shared L3 cache.
2. Memory: 12 GB DDR3-1066 MHz SDRAM.
3. Primary Hard Drive: 1.5 TB RAID 1 (2 x 1.5 TB SATA HDDS).
4. Secondary Hard Drive: 1.5 TB 7200 RPM SATA 2Gb/s.
5. CD Drive: Blu-Ray player and light scribe super multi DVD burner.
6. Graphics Card: 1 GB NVIDIA Geforce 460 2 DVI, mini-HDMI, VGA adapter.
7. 18.5 in. diagonal widescreen thin film transistor LCD active matrix, resolution 1366 x 768.
8. Keyboard and Mouse: USB keyboard and optical mouse.
9. Software: Microsoft Office Professional 2010.
10. HP Pavilion Elite HPE-800 Series, or equal.

D. Printer: Provide a workstation printer to display alarms and graphics. The printer is to be a HP Officejet Pro 8100, or equal.

2.7 WORKSTATION SOFTWARE

A. General Description:

1. The software architecture shall be object-oriented in design, a true 32-bit application suite utilizing Microsoft's OLE, COM, DCOM and ODBC technologies. These technologies shall make it easy to fully utilize the power of the operating system to share, among applications (and therefore to the users of those applications), the data available from the Temperature Control System.

   a. The workstation functions shall include monitoring and programming of all BMS controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.

   b. Programming of controllers shall be capable of being done either off-line or on-line from any operator workstation. All information shall be available in graphic or text displays. Graphic displays shall feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the BMS system. All operator functions shall be selectable through a mouse.

2. The file server database engine shall be Microsoft SQL Server, or another ODBC-compliant, relational database program. This ODBC (Open Database Connectivity) compliant database engine shall allow for an Owner to utilize "their" choice of database and due to its "open" architecture, shall allow an Owner to write custom applications and/or reports that communicate directly with the database avoiding data transfer routines to update other applications. The system database shall contain all point configurations and programs in each of the controllers that have been assigned to the network. In addition, the database shall contain all workstation files including color graphic, alarm reports, text reports, historical data logs, schedules, and polling records.

3. The BMS workstation software shall allow the creation of a custom, browser-style interface linked to the user that has logged into the workstation software. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface shall be able to be configured to become a user's "PC Desktop" - with all the links that a user needs to run other applications. This, along with the Microsoft Office Professional 2010 user security capabilities, shall enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BMS software but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.

4. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be

linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system shall allow a minimum of 256 users to be configured per workstation. There shall be an inactivity timer adjustable in software that automatically logs off the current operator after the timer has expired.

5. The workstation software shall use a familiar Windows Explorer style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions. Object names shall not be required to be unique throughout the system allowing for point naming convention consistency. For example, each Air Temperature Unit Controller can have an input called Space Temperature and a setpoint called CFM Setpoint.

    a. The configuration interface shall also include support for template objects. These template objects shall be used as building blocks for the creation of the BMS database. The types of template objects supported shall include all data point types (input, output, string variables, setpoints, etc.), alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of template object types shall be able to be set up as template subsystems and systems. The template system shall prompt for data entry if necessary. The template system shall maintain a link to all "child" objects created by each template. If a user wishes to make a change to a template object, the software shall ask the user if he/she wants to update all of child objects with the change. This template system shall facilitate configuration and programming consistency and afford the user a fast and simple method to make global changes to the BMS.

6. Color Graphic Displays: The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic using the mouse. Requirements of the color graphic subsystem include:

    a. LCD active matrix, resolution 1366 x 768 displays. The user shall have the ability to import AutoCAD generated picture files as background displays.

    b. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, and graphs which can be "dropped" on a graphic using a software configuration "wizard". These objects shall enable

operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.

c. Status changes or alarm conditions shall be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.

d. Graphic panel objects shall be able to be configured with multiple "tabbed" pages allowing an operator to quickly view individual graphics of equipment, which make up a subsystem or system.

e. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators shall be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.

7. The software shall allow for the automatic collection of data and reports from any controller through either a hardwire or modem communication link. The frequency of data collection shall be completely user-configurable.

8. The software shall be capable of accepting alarms directly from controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) shall be integrated into the overall alarm management system and shall appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports. Alarm management features shall include:

a. A minimum of 255 alarm notification levels, or classes of alarms. Each notification level shall establish a unique set of parameters for controlling alarm display, acknowledgment, keyboard annunciation, alarm printout and record keeping.

b. Automatic logging in the database of the alarm message, point name, point value, connected controller, timestamp, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).

c. Automatic printing of the alarm information or alarm report to an alarm printer or report printer.

d. Playing an audible beep or audio (wav) file on alarm initiation or return to normal.

e. Sending an email or text message to anyone listed in a workstation's email account address list on either the initial occurrence of an alarm and/or if the alarm is repeated because an operator has not acknowledged the alarm within a user-configurable timeframe. The ability to utilize

email and texting of alarms shall be a standard feature of the software integrated with the operating system's mail application interface (MAPI). No special software interfaces shall be required.

f. Individual alarms shall be able to be re-routed to a workstation or workstations at user-specified times and dates. For example, a critical high temperature alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.

g. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.

h. The font type and color, and background color for each alarm notification level as seen in the active alarm viewer shall be customizable to allow easy identification of certain alarm types or alarm states.

i. The active alarm viewer can be configured such that an operator shall type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.

9. The software shall contain a built-in custom report generator, featuring word processing tools for the creation of custom reports. These custom reports shall be able to be set up to automatically run or be generated on demand. Each workstation shall be able to associate reports with any word processing or spreadsheet program loaded on the machine. When the report is displayed, it shall automatically spawn the associated report editor, which shall be the most recent version of Microsoft Office.

a. Reports can be of any length and contain any point attributes from any controller on the network.

b. The report generator shall have access to the user programming language in order to perform mathematical calculations inside the body of the report, control the display output of the report, or prompt the user for additional information needed by the report.

c. It shall be possible to run other executable programs whenever a report is initiated.

d. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.

e. Standard reports shall include:

1) Points in each controller.
2) Points in alarm.
3) Disabled points.

4) Overridden points.
5) Operator activity report.
6) Alarm history log.
7) Program listing by controller with status.
8) Network status of each controller.

10. Spreadsheet-Style Reports: The software shall allow the simple configuration of row/column (spreadsheet-style) reports on any class of object in the system. These reports shall be user-configurable and shall be able to extract live (controller) data and/or data from the database. The user shall be able to set up each report to display in any text font, color and background color. In addition, the report shall be able to be configured to filter data, sort data, and highlight data that meets user-defined criteria.

11. HTML Reporting: The above spreadsheet-style reports shall be able to be run to an HTML template file. This feature shall create an HTML "results" file in the directory of the HTML template. This directory can be shared with other computer users, which shall allow those users with access to the directory to "point" their web browser at the file and view the report.

12. Scheduling: It shall be possible to configure and download from the workstation schedules for any of the controllers on the network.

    a. Time of day schedules shall be in a calendar style and shall be programmable for a minimum of one year in advance. Each standard day of the week and user-defined day types shall be able to be associated with a color so that when the schedule is viewed it is very easy, at-a-glance, to determine the schedule for a particular day even from the yearly view. To change the schedule for a particular day, a user shall simply click on the day and then click on the day type.

    b. Each schedule shall appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.

    c. Schedules shall be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation shall be automatically updated to the corresponding schedule in the controller.

13. The programmer's environment shall include access to a superset of the same programming language supported in the controllers. In this environment, the programmer shall be able to configure application software off-line (if desired) for custom program development, write global control programs, system reports, wide area networking data collection routines, and custom alarm management software. On the same screen as the program editor, the programming environment shall include dockable debug and watch bars for program debugging and viewing updated values and point attributes during programming. In addition, a wizard tool shall be available for loading programs from a library file in the program editor.

14. The workstation software shall have an application to save and restore field controller memory files. This application shall not be limited to saving and reloading an entire controller - it shall also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

15. The workstation software shall have the capability to easily configure groups of data points with trend logs and display the trend log data. A group of data points shall be created by drag-and-drop method of the points into a folder. The trend log data shall be displayed through a simply menu selection. This data shall be able to be saved to file and/or printed.

16. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.

17. Fault Tolerant File Server Operation: The system shall provide the option to provide fault tolerant operation in the event of the loss of the CPU, disk drives, or other hardware required to maintain the operational integrity of the system. Operational integrity includes all user interfaces, monitoring of alarm points and access points, and executing access control functions. Fault tolerant technology is not provided unless specifically stated.

    a. The switchover mechanism provided shall be automatic. Should the failure be caused by hardware, then the system shall immediately switch to the Backup computer. Should the system failure be caused by software (instruction or data), the system shall not pass the faulted code to the Backup computer, otherwise the Backup shall fail in the same manner of the Primary computer.

    b. Switchover to the Backup computer shall be initiated and effective (complete) in a manner and time frame that precludes the loss of event data, and shall be transparent to the system users, except for an advisory alarm message indicating that the switchover has occurred.

    c. When the system fails-over from the Primary to the Backup computer, no alarm or other event shall be lost, and the Backup computer shall take control of all system functions.

    d. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.

    e. The Primary computer shall provide continual indication that the Backup computer is unavailable until such time that the fault has been purged.

2.8 WEB BROWSER INTERFACE

A. Provide a web browser interface that will be accessible to any computer on the Owner's Intranet with Microsoft Internet Explorer 8.0 or higher. The system shall support a minimum of 5 simultaneous users to access the system. The Web Browser Interface shall include the following features.

1. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any site in the system from anywhere on the network.

2. The browser-based interface must share the same graphical displays as the Operator Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall also support commands to change setpoints, enable/disable equipment and start/stop equipment.

3. Through the browser interface, operators must be able to navigate through the entire system, and change the value or status of any point in any controller. Changes are effective immediately to the controller, with a copy stored in the system database.

4. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically.

5. Through the browser interface, operators must be able to change schedules - change start and stop times, and add new times to a schedule.

6. Through the browser interface, operators must be able to create and edit card access personnel records, and assign the card to any and all sites for access, in any combination.

7. Through the browser interface, operators must be able to view reports of access events and access privileges. Reports must be available based on start and end time, door, area, and person. Invalid attempts must be color-coded red in the report.

8. Through the browser interface, operators must be able to view live and recorded video from any digital video recorder on the network. The interface must offer an easy method of selecting the camera to view, and for recorded video, must offer selections for start and stop time when searching video clips.

9. All commands and user activity through the browser interface shall be recorded in the system's activity log, which can be later searched and retrieved by user, date, or both.

10. The same user accounts shall be used for the browser interface and for the operator workstations. Operators must not be forced to memorize multiple passwords.

11. The system shall be expandable to up to 25 concurrent browser-based users per server.

2.9 SURGE SUPPRESSION (SP) RECEPTACLE

A. Provide at each DDC panel and operator workstation locations, a surge suppression receptacle with metal oxide varister to dissipate the electrical energy of voltage spikes. 20 ampere, duplex, NEMA 5-20R configuration. Back and side wiring, high impact nylon body.

B. Acceptable Make: Hubbell 5352-S.

2.10 GRAPHICS

A. System Graphic:

1. The equipment drawing will be three-dimensional. The values on the screen shall be reported in real time as well as dynamic to be updated as the value changes.

2. All components of the drawing will show their actual field location and position. Sensors will be in the exact location in reference to piping and air stream. Icons or "library" images imported during the construction of the drawing will be accurate in depiction of the device and any interaction with other components of the drawing, i.e. don't draw piping into the motor of a pump icon.

3. If there are size limitations or clutter from the number of components a link to a sub graphic having the same layout will be used to clarify.

B. Space Graphic:

1. Floor plan drawings will be linked to the supplying air handling unit or in some cases to the exhaust fan. Electronic floor plans to be provided by Architect/Engineer.

2. Floor plans showing areas served by more than one air handling unit will have the areas color-coded by air handling unit. If the air-handling unit serves different floors the color will be consistent for an air-handling unit for all floors.

3. If an area has control other than DDC it will be noted with text and left white in the background.

4. A temperature zone serving more than one space shall have a unique pattern, to distinguish that zone from other temperature zones. The patterns should slight enough as to not obscure the space temperature, room number and borders detail but visible enough to be able to distinguish between different zones. A different "peppering" of symbols (of + ˆ * ≈) or patterns (hex, herringbone, verticals, etc.) will be used to define the zones.

5. Temperature zones dedicated to only one space will not have to be detailed.

6. Remote physical points such as differential monitors and the like shall be shown in their installed location.

C. The second level of graphics shall be all the DDC points to be installed under the contract overlaid on building floor plan and the Air Handling Unit and its associated systems. Electronic floor plans to be provided by Architect/Engineer.

D. Description of Operation:

1. The approved description of operation will appear on a text graphic in 12-point text written in paragraph form.

2. Additional notes may appear on the equipment graphic in an appropriate location.

E. Layout:

1. The subject device of equipment graphic will be centrally located on the drawing.

2. At the top center, the name of the equipment device will be displayed with its room number. Immediately below the PM# will be displayed. On a third line will be the capacity of the device in units common to that device i.e. air handling units in CFM, pumps in GPM.

3. The top right hand corner will contain links to associated graphics. The Description of Operation, submittal graphic, space graphic and graphic index page will be typical. Other links may be required. All graphic pages will have backward link to return to the main System Graphic.

4. The top left-hand corner will contain global data. Outside Air would be the most common other values may be required when related to the device operation. If the global data functions within the program of this unit, the point referenced in the program will be displayed.

5. The lower left-hand corner will display the operational modes of the device. Occupied, warm up, winterized and economizer would be common. Other modes will be displayed if the unit uses them.

6. In the upper right-hand area, just below the links, the setpoints of the device will be displayed. All setpoints in the various control loops of the device, DA temp, static pressure, MA will be placed in columns as the drawing permits.

7. The date of the last revision of the graphic will be displayed in the lower right corner.

F. Text:

1. Text will contrast with the background for easy reading.

2. The text will be free floating without borders or boxes unless specifically required.

G. The graphics shall include approved schematic of the equipment, sequence of operation and all wiring interface diagrams.

H. The graphic shall include all new systems, equipment and spaces.

PART 3 - EXECUTION

3.1 GENERAL SYSTEM REQUIREMENTS

A. The control of each system shall be guaranteed to perform as described in the Sequence of Operation on the drawings. Equipment, remote switches, in finished rooms shall be flush-mounted, if possible. Interlock supply and return fans, humidifiers with fans, condensers or cooling towers with air conditioning equipment and similar situations demanding coordinated operation.

3.2 SYSTEM COMPONENTS

A. Valves: Union or flanged connected. Locate close to apparatus controlled with pipe reducers and increasers located closest to valve. Locate, arrange, and pipe per installation diagram.

B. Mounting height for all room thermostats or sensors shall be 48 in. to the top of the cover.

C. Locate thermostats on walls symmetrical with adjacent items. Verify exact room location to avoid doors, fixed and portable equipment. Install to minimize damage. Do not install adjacent to lighting dimmers or other heat generating equipment.

D. Dampers and Damper Operators: Tag dampers for proper location. Install per manufacturer's printed instruction as to motor size and quantity, linkage arrangement, drive connection point. Adjust to close tightly. Allow for conduit sleeve or blank space for roof fan dampers. Where ducts are insulated, set damper operators at least 2 in. away from side of duct to allow for insulation.

3.3 SMOKE DAMPERS AND FIRE/FAN SHUT DOWN

A. Provide control for smoke dampers as required. Division 26 "Electric" to provide 120 volt power wiring and associated signal wiring to close all smoke partition smoke dampers associated with a particular air handling unit upon alarm at any duct smoke detector in that particular system. Coordinate the voltage of the EP switch with Division 26 "Electric".

B. Division 26 "Electric" to provide a signal to stop air handling unit fans and close air handling unit smoke dampers upon activation of the fire alarm system. Wiring to be directly to the motor starter.

C. The DDC Contractor/Subcontractor shall provide control wiring for a digital input point for an end switch that shall prevent the operation of the air handling unit fans until its corresponding smoke dampers are proven fully open.

D. Division 26 "Electric" shall also provide a signal to the DDC control system that the fire alarm system is activated.

3.4 LOW AND HIGH LIMIT SAFETY FUNCTIONS

A. Provide for all supply fan units. Wiring to be directly to the motor starter. High limit controller (firestat) shall be located in the unit discharge, set at 180°F and prevent the fan from operating until reset. High limit shall alarm DDC system. Low limit shall be strung on the discharge face of preheat coils set at 37°F. Low limit shall: prevent fan from operating, set heating coils to full heat, fully close the outside air damper, fully close the relief air dampers, open return air damper, and alarm DDC system until reset.

3.5 SYSTEM TESTING AND COMMISSIONING

A. At the time of installation, systems shall be tested for control device operation prior to the systems acceptance. A report of each systems performance shall be submitted to the Owner's Representative. The report shall include:

1. Field verification and demonstration checklist of analog input calibration, analog output operation, digital input function, and digital output operation.

2. Trend log of inputs and output, printed every two (2) hours, for one (1) week.

3. Refer to "Instructions and Adjustments".

3.6 SYSTEM DESCRIPTION - GENERAL

A. All systems shall maintain the scheduled or otherwise noted minimum outside air ventilation rate during building occupied hours.

B. Provide normally open hot water and normally closed cooling coil valves.

C. Provide normally open return air damper, normally closed relief air and normally closed outside air dampers and operators.

D. Mode of operation (occupied/unoccupied) including building warm-up and pull-down cycles, as well as all system functions shall be programmable and controlled by the BMS system.

E. Shutdown of air handling units and fans due to a fire alarm shall be by the Electrical Contractor. The fire alarm system will send a signal to the BMS system for monitoring purposes only of each air handling unit and exhaust system. The BMS system will provide a staggered restart of the units once the alarm is cleared.

F. All setpoints shall be adjustable.

G. Two (2) outside air temperature sensors and two (2) outside air humidity sensors are to be provided as general inputs to the BMS system. The pair of readings shall be averaged for use by the system. If an individual reading is found to be out of range by comparison, then the other reading shall be used, and an alarm shall be generated.

H. Where the normal sequence position or status of a device is allowed to be manually over-ridden by the building Owner/operator, the device shall be returned to its normal "system off" position, if the system is shut down by the BMS system or building fire alarm system. This includes overriding manually set and locked setpoints. Upon system restart, the device shall return to its manually over-ridden status. Returning devices to their normal "systems off" position shall be done to reduce the potential of damage to the systems.

3.7 CONTROL SEQUENCE

A. Refer to plans for control diagrams, sequences and points lists.

END OF SECTION

SECTION 232010 - PIPING SYSTEMS AND ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services as required for the complete installation designed in Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 078413 - Penetration Firestop Systems.

1.3 SUBMITTALS

A. Anchors and guides. Provide detailed fabrication drawings for all field-fabricated anchors and intermediate structural elements.

B. Schedule of pipe materials, fittings and connections.

C. Grooved mechanical connection system.

D. Pressed mechanical connection system.

E. Shop fabricated tees.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pipe and fittings shall be new, marked with manufacturer's name and comply with applicable ASTM and ANSI Standards.

B. All adhesives, sealants, primers and paint used for piping in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

2.2 STEEL PIPING AND FITTINGS

A. Pipe: ASTM A53, Schedule 40 weight; black or galvanized finish as called for; ends chamfered for welding or roll grooved for grooved mechanical connections.

B. Fittings: Same material and pressure class as adjoining pipe.

1. Welded Fittings: Factory forged, seamless construction, butt weld type, chamfered ends. Where branch connections are two or more sizes smaller than main size, use of "Weldolets", "Thredolets", or "Sockolets" are acceptable. Mitered elbows, "shaped" nipples, and fabricated reductions and fabricated branch connections are not acceptable unless specifically required and reviewed by the Engineer**.** Socket weld type, 2000 psi wp, where required.

2. Threaded Fittings: Cast or malleable iron, black or galvanized, as required; drainage type where called for.

C. Flanges, Unions and Couplings:

1. Threaded Connections:

a. Flanges: Cast iron companion type; for sizes 2-1/2 in. and larger.

b. Unions: Malleable iron, bronze to iron seat, 300 lb. wwp; for sizes 2 in. and smaller.

c. Couplings: Malleable iron, 150 or 300 lb. wwp, based on system pressure. Steel thread protectors are not acceptable as couplings.

2. Welded Connections:

a. Flanges: Welding neck type.

b. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents and working temperatures and pressures. ASME B16.21, nonmetallic, flat, asbestos free, 1/8 in. maximum thickness unless thickness or specific material is indicated. Flexitaulic CG or GCI spiral wound semi-metallic gaskets, where applicable.

c. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

3. Grooved Mechanical Connections:

a. Couplings: Ductile iron, ASTM A536, with painted coating, designed for rolled grooved piping, hot dipped galvanized finish were required.

1) Grade "EHP" EPDM synthetic rubber, -30°F to 250°F temperature range, suitable for water service.

2) Gasket lubricant furnished by coupling manufacturer.

b. Bolts and Nuts: Head treated, hex head carbon steel (ASTM A183 and A449) cadmium plated or zinc electroplated.

c. Fittings: Elbows, tees, laterals, reducers, adapters as required. Same construction as couplings. The use of mechanical tees is permitted only when a branch size is two or more sizes smaller than the main size. Reducing couplings, strapless mechanical tees and segment-welded elbows are not acceptable.

d. Design Equipment: Victaulic rigid system, Style 107N Quick Vic couplings for 12 in. and smaller.

e. Make: Victaulic, Anvil, Tyco/Grinnell, Shurjoint.

D. Gauge and Instrument Connections: Nipples and plugs for adapting gauges and instruments to piping system shall be IPS brass.

E. Base Elbows:

1. Cast iron or steel type, flange connections; Crane 500 or equivalent. Made from welding elbows, with welded pipe support and steel base. Reducing elbows where necessary.

ELBOW SIZE	SUPPORT SIZE	BASE PLATE
2 in. to 3 in.	1-1/4 in.	6 in. x 6 in. x 1/4 in.
4 in. to 6 in.	2-1/2 in.	8 in. x 8 in. x 1/4 in.
8 in. and larger	6 in.	14 in. x 14 in. x 5/16 in.

2. Anchor bolt holes in each corner of base for securely bolting to floor or concrete base; minimum 3/4 in. bolts.

2.3 COPPER TUBE AND FITTINGS - SOLDER JOINT

A. Pipe: ASTM B88; Type K, L or M, hard temper. Soft temper only where specified. Plans show copper tube sizes.

B. Tees, Elbows, Reducers: Wrought copper, ANSI B16.22 or cast bronze; ANSI B16.8 solder end connections.

C. Unions and Flanges: 2 in. and smaller use unions, solder type, cast bronze, ground joint, 150 lb. swp: 2-1/2 in. and over use flanges, cast bronze, companion type, ASME drilled, solder connection, 150 lb. swp.

D. Solder Materials: No-lead solder, using alloys made from tin, copper, silver and nickel.

E. Make: Harris "Stay-Safe 50" and "Bright", Engelhard "Silverbright 100", Willard Industries "Solder Safe (silver bearing), Canfield "Watersafe" or approved equal.

2.4 COPPER TUBE AND FITTINGS - PRESS FITTINGS

A. Tubing Standard: Copper tubing shall conform to ASTM B75 or ASTM B88.

B. Fitting Standard: Copper fittings shall conform to ASME B16.18, ASME B16.22, or ASME B16.26.

C. Press Fitting: 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.

D. Make: Viega Pro-Press, Nibco, Tyco Grinnell, Elkhart Apolloxpress, Mueller.

2.5 COPPER DRAINAGE TUBE AND FITTINGS - SOLDER JOINT

A. Pipe: ASTM B306, Type DWV, hard temper.

B. Fittings: Wrought copper, ANSI B16.29 or cast bronze, ANSI B16.23; solder end connections.

C. Solder Materials: No lead solder, using alloys made from tin, copper, silver and nickel.

D. Make: Harris "Stay-Safe 50" and "Bright", Engelhard "Silverbright 100", Canfield "Watersafe" or approved equal.

2.6 COPPER TUBE AND FITTINGS - GROOVED MECHANICAL CONNECTIONS

A. Pipe: ASTM B88, Type K or L, hard temper.

B. Fittings: Wrought copper, roll grooved mechanical connections, ASTM B-75, ANSI B16.22 for sizes 2 in. - 4 in. Cast bronze, rolled grooved mechanical connections, ASTM B-584, ANSI B16.18 for sizes 5 in. - 8 in., with copper tube dimensioned grooved ends designed to accept rolled grooved couplings (flaring of tube and fitting ends to IPS dimensions is not permitted).

C. Couplings: Ductile iron, ASTM A-536, with copper colored alkyd enamel finish, designed for rolled grooved piping. Housings cast with offsetting, angle pattern, bolt pads to provide rigidity.

D. Gaskets: Grade "EHP" EPDM synthetic rubber, color-coded, -30°F to 250°F temperature range, suitable for water service.

E. Bolts and Nuts: Heat treated, hex head carbon steel, ASTM A183 and A449, cadmium plated or zinc electroplated finish.

F. Design Equipment: Victaulic Style 607 couplings.

G. Make: Victaulic, Anvil, Tyco/Grinnell, Shurjoint.

2.7 COPPER TUBE AND FITTINGS - BRAZED JOINT

A. Pipe: ASTM B88, Type K or L, hard temper.

B. Tees, Elbows and Reducers: Wrought copper, ANSI B16.22 or cast bronze, ANSI B16.18.

C. Unions and Flanges: Unions for 2 in. and smaller. Brazed type cast bronze ground joint, 150 lb. swp; flanged for 2-1/2 in. and larger, brazed type, cast bronze, companion type, gasketed and bolted, ASME drilled 150 lb. swp.

D. Brazing Materials: Class BcuP-2 for brazing copper to brass, bronze or copper. Harris, Inc. Stay-Silv 0 or approved equal.

2.8 DIELECTRIC PIPE FITTINGS

A. Description: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

B. Unions: Factory fabricated, for 250 psi minimum working pressure at 180°F, threaded or solder ends, insulating material suitable for system fluid, pressure and temperature.

C. Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum pressure to suit system fluid pressures and temperatures with flange insulation kits and bolt sleeves.

D. Waterway Fittings: 300 psi maximum working pressure at 230°F, male threaded or grooved ends, electroplated ductile iron or steel body with LTHS high temperature polyolefin polymer liner.

E. Make: EPCO, Capitol Manufacturing, Watts, Victaulic, or approved equal.

F. The use of brass valves, brass nipples (3 in. and larger) and Shurjoint epoxy coated transition coupling IPS-CTS may be used for dielectric isolation. Dielectric transition fittings shall be Shurjoint Model DE30-GG for sizes 2 in. through 8 in., which shall provide effective insulation between the steel and copper systems to avoid galvanic local cell and stray current problems. The dielectric transition fitting shall be made of ductile iron per ASTM A536 Gr. 65-45-12, electric deposition coated, with a virgin PP (propylene) lining.

2.9 REFRIGERATION PIPING

A. Type L hard temper deoxidized, dehydrated, and sealed copper tubing, refrigerant grade.

B. Refrigerant grade wrought copper fittings. Long radius elbows.

C. Factory made suction traps, Melco Type PT.

D. Piping and system shall meet the requirements of Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1994 and ASME/ANSI B31.5.

E. Make: Mueller, Howell Metal, Cerro, Cambridge-Lee, Universal Tube.

2.10 HANGERS, INSERTS, AND SUPPORTS

A. Hangers, Inserts, Clamps: B-Line, Grinnell, Michigan Hanger, PHD Manufacturing, Anvil, Hilti.

B. Hangers:

1. Adjustable, wrought malleable iron or steel with electroplated zinc or cadmium finish. Copper plated or PVC coated where in contact with copper piping. Hot-dipped galvanized finish for exterior locations.

2. Adjustable ring type where piping is installed directly on hanger for piping 3 in. and smaller.

3. Adjustable steel clevis type for 4 in, and larger, and where insulation passes through hanger.

4. Hangers sized to permit passage of insulation through the hanger for all piping.

5. Nuts, washers and rods with electroplated zinc or cadmium finish. Hot-dipped galvanized finish for exterior locations.

C. Hanger Shields:

1. Pre-Insulated Type:

a. Insulated pipes shall be protected at point of support by a 360° insert of high density, 100 psi waterproof calcium silicate, encased in a 180° sheet metal shield. Insulation insert to be same thickness as adjoining pipe insulation and extend 1 in. beyond sheet metal shield. Insulation shall be provided with a factory installed ASJ.

2. Field-Insulated Type:

a. #18 USSG, galvanized steel shields, minimum 120° arc. Provide ICA-HAMFAB-BLOCK, 18# density molded fiberglass inserts, between pipe and hanger shield to maintain proper spacing for insulation. Insulation inserts shall extend 1 in. beyond the sheet metal shields. Material shall comply with ASTM E84 25/50, have a thermal conductivity of K=.30 (stable) and have a service temperature of -120°F to +650°F. Install in accordance with manufacturer's printed instructions.

3. Shield Sizing:

PIPE SIZE	SHIELD LENGTH	MINIMUM GAUGE
1/2 in. to 3-1/2 in.	9 in.	20
4 in.	9 in.	20
5 in. and 6 in.	9 in.	20
8 in. to 12 in.	12 in.	18
14 in. to 24 in.	18 in.	16

4. Hanger shield gauges listed are for use with band type hangers only. For point loading (roller support), increase shield thickness by one gauge, and length by 50%.

D. Hanger Spacing Schedules: (Based upon most stringent requirement of MCNYS and ASME B31.9)

COPPER OR PLASTIC PIPE SIZE	COPPER PIPE HANGER SPACING	PLASTIC PIPE HANGER SPACING	HANGER ROD SIZE
3/4 to 1 in.	6 ft.	3 ft.	3/8 in.
1-1/4 in.	6 ft.	4 ft.	3/8 in.
1-1/2 to 2 in.	8 ft.	4 ft.	3/8 in.
2-1/2 to 4 in.	10 ft.	4 ft.	1/2 in.
5 in. and larger	10 ft.	4 ft.	3/4 in.

STEEL PIPE SIZE	STEEL PIPE HANGER SPACING	HANGER ROD SIZE
3/4 to 1 in.	8 ft.	3/8 in.
1-1/4 in.	10 ft.	3/8 in.
1-1/2 to 2-1/2 in.	12 ft.	3/8 in.
3 to 4 in.	12 ft.	1/2 in.
5 in. and larger	12 ft.	3/4 in.

E. Inserts: Carbon steel body and square insert nut, galvanized finish, maximum loading 1,300 lbs., for 3/8 in. to 3/4 in. rod sizes. Drill through decking for hanger rods and secure devices with integral support plate strap with sheet metal screws. Devices shall have a safety factor of four.

F. Beam Attachments:

1. C-Clamp, locknut, electroplated finish, UL listed, FM approved, for pipe sizes 2 in. and smaller.

2. Center load style with clamp attachments that engage both edges of beam, electroplated finish, UL listed, FM approved, for pipe sizes larger than 2 in., refer to "Supports" for additional requirements.

3. Welded beam attachments may be considered only upon the review and acceptance of the structural engineer of record with written confirmation of weld meet configuration, location and service/pipe size submitted to the Mechanical Engineer for review.

G. Supports:

1. Provide intermediate structural steel members where required for hanger attachment. Secure member to structure. Select size of members based on a minimum factor of safety of four.

2. For Weights Under 1000 lbs.: Insert, "U" shaped channel, beam clamps or other structurally reviewed support. The factor of safety shall be at least four. Follow manufacturer's recommendations.

3. For Weights Above 1000 lbs.: Drill through floor slabs and provide flush plate welded to top of rod or provide additional inserts and hangers to reduce load per hanger below 1000 lbs.

4. Make: Hilti, ITW Ramset, Phillips "Red Head", or approved equal.

H. Trapeze Hangers:

1. For use on 1-1/2 in. and smaller piping only.

2. Hangers shall be supported with rod sized with a safety factor of four.

3. May be manufactured type "U" shaped channel, or suitable angle iron or channel. Round off all sharp edges.

4. Securely fasten piping to trapeze with "U" bolt or straps, dissimilar metals shall not touch, use isolation gaskets.

5. Make: B-Line, Kindorf, Unistrut, or approved equal.

2.11 PIPING ACCESSORIES

A. Escutcheon Plates: Provide escutcheon plates on uninsulated piping in exposed and finished areas. Steel or cast brass polished chrome, split hinge type with setscrew, high plates where required for extended sleeves.

B. Pipe Guides: Cylindrical steel guide sleeve, proper length for travel, integral bottom base anchor, top half removable. Split steel spider to bolt to pipe, copper plated spider for copper pipe. Insulated style where pipe is required to be insulated. Make: Tri-State Industries, or equal.

C. Anchors:

1. Pipe support; same material as pipe; as manufactured by Pipe Shields Model C1000 or C2000, Keflex, Metraflex, Flexonics or Advanced Thermal Systems.

2. Pipe Anchors:

a. Anchors shall be designed and located as to prevent stress to piping or building structural components from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stressing to connected equipment.

3. All field or shop fabricated anchor and equipment and piping supports shall include detail fabrication drawings submittals accompanied by comprehensive structural engineering design and analysis by a qualified, profession engineer licensed to practice in the State of New York, using the performance and design criteria specific to the project and system in question.

D. Pipe Roll Stand: Cast iron roll stand. Make: Advanced Thermal Systems, Carpenter and Patterson, ITT Grinnell, Pipe Shields.

2.12 SLEEVES

A. Standard Type:

1. Schedule 40 black steel pipe sleeves shall be used for sleeves in horizontal and vertical applications through structural surfaces. Sleeves shall extend a minimum of 1 in. beyond both sides of the structure surface being penetrated. The sleeve shall be sized to account for the total diameter of the service, inclusive of insulation and the appropriate annular space for firestopping installation or requirements of the sealing element manufacturer.

2. Full circle water stop collar for sleeves located in below grade walls, wet wells and waterproofed surfaces. The collar shall be fabricated from steel plate and welded to the sleeve around its entire circumference.

3. Schedule 40, PVC sleeves or sheet metal sleeves for nonstructural surfaces. Sheet metal sleeves shall be 18 gauge minimum and braced to prevent collapsing. Sleeves shall extend a minimum of 1/2 in. beyond both sides of the non-structural vertical surface being penetrated. The sleeve shall be sized to account for the total diameter of the service, inclusive of insulation and the appropriate annular space for firestopping.

B. Pre-Insulated Type:

1. Adjustable or fixed length metal cans, 24 gauge minimum sized for 1 in. spacing between insulation and can. Insulation shall consist of a 360° waterproofed calcium silicate insert sized to extend 1 in. beyond wall or floor penetration. Calcium silicate insert shall be the same thickness as adjoining pipe insulation. Spacing between shield and can packed at each end with double neoprene rope positively fastened.

2.13 SEALING ELEMENTS

A. Expanding neoprene link type, watertight seal consisting of interlocking links with zinc plated bolts.

1. Make: Thunderline "Link-Seal" Series 200, 300 or 400, Pyropac, Calipco.

B. Waterproof Type:

1. Exterior Walls, Below Grade, Above Floor: Synthetic rubber material with zinc plated bolts. Make: "Link-Seal" Series 200, 300 or 400, Pyropac, Calipco.

2.14 FIRESTOP SYSTEM FOR OPENINGS THROUGH FIRE RATED WALL FLOOR ASSEMBLIES

A. Materials for firestopping seals shall be listed by an approved independent testing laboratory for "Penetration Firestop Systems". The system shall meet the standard fire test for Penetration Firestop Systems designated ASTM E814. Firestop system shall be provided at locations where piping passes through fire rated wall, floor/ceiling, or

ceiling/roof assembly. Minimum required fire resistant ratings of the assembly shall be maintained by the Firestop System. Installation shall conform with the manufacturer's recommendations and other requirements necessary to meet the testing laboratory's listing for the specific installation.

2.15 PIPING MATERIALS AND SCHEDULE

A. See Exhibit "A", "Schedule of Piping Materials" at end of this Section for (HVAC) piping.

PART 3 - EXECUTION

3.1 EQUIPMENT AND SYSTEMS

A. Provide equipment and systems in accordance with laws, codes, and provisions of each applicable section of these specifications. Accurately establish grade and elevation of piping before setting sleeves. Install piping without springing or forcing (except where specifically called for), making proper allowance for expansion and anchoring. Arrange piping at equipment with necessary offsets, union, flanges, and valves, to allow for easy part removal and maintenance. Offset piping and change elevation as required to coordinate with other work. Avoid contact with other mechanical or electrical systems. Provide adequate means of draining and venting units, risers, circuits and systems. Install drains consisting of a tee fitting with a 3/4 in. ball valve with hose end cap and chain, at low points in hydronic piping system mains, and elsewhere as required for system drainage.

B. Conceal piping unless otherwise called for. Copper tubing shall be cut with a wheeled tubing cutter or other approved copper tubing cutter tool. The tubing must be cut square to permit proper joining with the fittings. Ream pipes after cutting and clean before installing. Cap or plug equipment and pipe openings during construction. Install piping parallel with lines of building, properly spaced to provide clearance for insulation. Make changes in direction and branch connections with fittings unless submitted and accepted per Part 2. Do not install valves, union and flanges in inaccessible locations. Provide trap seal of adequate depth on drain pans.

C. Provide reducers at all control valves, where control valve is smaller than pipeline size. Reducers for steam control valves shall be eccentric type. Provide unions at each side of every control valve and reducers directly adjacent to the unions.

D. Provide reducers at all balance valves, where balance valve is smaller than pipeline size.

3.2 PIPING OVER ELECTRICAL EQUIPMENT

A. Contractor shall route piping to avoid installation directly over electric equipment, including, but not limited to panels, transformers, disconnects, starters, motor control center, adjustable speed drives and fused switches.

B. Piping shall not be installed in the dedicated electric and working space as defined by NEC 110. Dedicated electrical space is generally equal to the depth and width of electrical equipment, and extends 6 ft. above the electrical equipment, or to a structural

ceiling. Dedicated working space is a minimum of 30 in. wide or the width of equipment (whichever is larger) a minimum of 6 ft.-6 in. tall, with a depth of 3 ft. to 9 ft. depending on the voltage.

3.3 WATER SYSTEMS

A. Top connection for upfeed, bottom or side connection for downfeed. Grade off level; up in direction of flow and down toward drain.

3.4 REFRIGERATION PIPING

A. Fittings brazed with silver brazing alloy. Guarantee refrigerant charge for one year from date of final acceptance. Provide for flexibility at compressor connections. Piping and system shall meet the requirements of Mechanical Refrigeration Safety Code, ANSI B9.1. Clean piping, then pump-down and evacuate system to 0.1 in. VAC break vacuum with dry nitrogen and re-evacuate to 0.1 in. VAC and hold for four (4) hours; then charge system. Charge with refrigerant as recommended by manufacturer.

3.5 HANGERS, INSERTS AND SUPPORTS

A. Piping shall not be supported by wires, band iron, chains, or from other piping. Support each pipe with individual hangers from concrete inserts, welded supports, or beam clamps of proper configuration and point loading design requirements for each location including the designated safety factor. Trapeze hangers are acceptable for racking of multiple pipes of 1-1/2 in. or less in size. Follow manufacturer's safe loading recommendations. Suspend with rods of sufficient length for swing and of size as called for, using four nuts per rod. Provide additional rustproofed structural steel members, where required for proper support. Provide oversized hangers where insulation/supports must pass between pipe and hanger. Only concentric type hangers are permissible on piping larger than 2-1/2 in., "C" types are permitted for piping 2-1/2 in. and smaller. Provide riser clamps for each riser at each floor.

B. Provide a pipe hanger within 12 in. of pipe unions and piping connections to equipment, in order to facilitate disconnections of piping without pipe sagging.

3.6 HANGERS ATTACHED TO JOISTS

A. Individual hangers may be suspended directly from the bottom chord panel point provided that the sum of the concentrated loads within the chord panel does not exceed 100 pounds and the attachments are concentric to the chord. (Eccentrically loaded joists using beam clamps or other attachment methods are not acceptable.)

B. For nominal concentrated loads between panel chords, which have been accounted for in the specified uniform design load for the joists, this Contractor is to provide struts to transfer the load to a panel point on the opposite chord as reviewed and acceptable by the Structural Engineer of Record.

3.7 PIPE CONNECTIONS

A. Solder Connections: Nonacid flux and clean off excess flux and solder.

B. Press Connections: Copper press fittings shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

C. Brazed Connections: Make joints with silver brazing alloy in accordance with manufacturer's instructions. Remove working parts of valves before applying heat. "Walseal" fittings may be used; if sufficient alloy is showing, face braze such joints.

D. Threaded Connections: Clean out tapering threads, made up with pipe dope; screwed until tight connection. Pipe dope must be specific for each application.

E. Flanged Joints: Select appropriate gasket material, size, type and thickness for service applications. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

F. Dielectric Pipe Fittings: Provide dielectric protection devices at ALL equipment connections where dissimilar metals meet. In addition, provide dielectric unions in all open type piping systems (condensing water, domestic water, etc.) where dissimilar metals are to be joined. Dielectric protection devices are not required in typical closed systems such as heating water, chilled water, heat pump loop, etc. except for the equipment connections. Dielectric protection systems are not required for air or gas systems.

G. Grooved Mechanical Joints: Pipe to be prepared in accordance with the latest Grooving Specification of the manufacturer utilized. Pipe shall be checked to be sure it is free of indentations, projections; weld seams or roll marks on the exterior of the pipe over the entire gasket seating area. Pipe ends are to be square cut. Lubricant shall be applied to gasket and/or pipe ends and housing interiors to eliminate pinching the gasket. All grooved couplings, fittings, and specialties shall be the products of a single manufacturer. A factory-trained field representative of the mechanical joint manufacturer shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Provide a field report verifying that factory trained representative has provided on-site training and that Contractor has coupled recommended installation procedures. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

H. HDPE Pipe Connections: Shall be joined by heat fusion. All procedures shall meet the requirements of Title 49 of the Code of Federal Regulations 192.285 as it applies to heat fusion.

3.8 WELDING

A. Welding shall be performed in compliance with the welding procedure specifications prepared by the National Certified Pipe Welding Bureau. Welded pipe fabricated by certified welder. Contractor shall submit proof of current certification of each welder if requested by Owner. Use full-length pipe where possible; minimum distance between welds, 18 in. on straight runs. Welds must be at least full thickness of pipe inside smooth

and remove cutting beads, slag and excess material at joints; chamfer ends. Minimum gap 1/8 in., maximum 1/4 in., for butt welds. One internal pass and one external pass minimum required on slip-on flanges. Do not apply heat to rectify distorted pipe due to concentrated welding; replace distorted pipe. When welding galvanized pipe, apply cold galvanizing on joint after welding.

3.9 HANGER SHIELDS

A. Provide at hangers for allpiping. Pre-insulated type or field-insulated type at Contractor's option.

3.10 SLEEVES

A. Provide for pipes passing through floors, walls or ceilings. Pre-Insulated Type: Required for all piping.

B. Standard Type: Provide for piping, except as called for.

C. Extend 1/8 in. above finished areas. In above grade mechanical and other areas with floor drains; use steel pipe sleeves 2 in. above floor. Use pipe sleeves in bearing walls, structural slabs, beams and other structural surfaces, and where called for. Sleeves shall be as small as practical, consistent with insulation, so as to preserve fire rating. Fill abandoned sleeves with concrete. Provide rubber grommet seals for pipes passing through ducts or air chambers or built-up housings.

3.11 ANCHORS

A. Provide piping system anchors where shown on the plans, and as recommended by the expansion joint/loop manufacturer. Where an anchor is shown at a change in piping direction, it shall fully control movement in both directions. In lieu of a single anchor fabricated for two directional control, two (2) individual anchors may be provided. Provide detailed fabrication drawings for all field-fabricated anchors.

B. Design anchors and equipment and piping supports including comprehensive structural engineering analysis by a qualified professional engineer, licensed to practice in the State of New York using the performance and design criteria specific to this project.

3.12 ALIGNMENT GUIDES

A. Provide alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two (2) or more guide(s) on each side of flexible expansion loop. Install guides nearest to expansion joint not more than four (4) pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

3.13 SLEEVE PACKING

A. Seal void space at sleeves as follows:

1. Interior Locations: Firmly pack with fiberglass and caulk.

2. Exterior Walls and Below Grade Cored Holes: Use sealing element.

3. Fire Rated, Partitions and Floor Slabs: Use fire rated sealing elements, materials and methods. Provide per manufacturer's instructions to maintain firestop.

4. Waterproofed Walls and Floors: Use waterproof sealing element, device, or compound.

3.14 ESCUTCHEON PLATES

A. Provide polished chrome escutcheon plates for uninsulated exposed piping passing through floors, walls or ceilings in finished areas.

3.15 CLEANING HOT WATER AND CHILLED WATER AND DUAL TEMP SYSTEMS

A. Provide the services of an experienced Water Treatment Subcontractor.

B. After each closed system has been tested and thoroughly flushed, the entire piping system shall be cleaned by, or as per, the Water Treatment Subcontractor.

C. Operate pumps and arrange control system so that all control valves are open. Fill, vent and circulate system with this solution, while rising to design temperature.

D. Remove, clean and/or replace air vents, strainers, and check valves, which do not function properly. After cleaning strainers, circulate for additional time, then clean strainers again; repeat until strainers are found clean. Drain and refill system.

E. Provide a batch chemical feed tank, valving and accessories as shown in the Contract Documents. Add water treatment as necessary to prevent deterioration of piping systems and equipment due to oxygen, acid, scaling, etc. Submit typewritten letter to inform Owner's Representative upon completion of the work.

F. Pumps shall not be operated continuously until system is flushed, strainers cleaned and water treatment is complete.

G. Water Treatment:

1. After system cleaning, furnish report of water test to determine quality.

2. Provide complete water treatment facilities to Owner, including water analysis, feed equipment, metering equipment, pumps, and chemical, obtained from Calgon, Vulcan, Bird Archer, Heating Economy Service, Inc., Mogul, Garratt-Callahan Company, Metropolitan, or Allen-Murray.

3. Recommendations for water treatment reviewed by Owner's Representative before systems are placed into service.

4. Add water treatment as necessary to prevent deterioration of piping system and equipment due to oxygen, acid, scaling, etc.

5. Water treatments shall be deemed complete when circulation has been established throughout, and water runs clear and clean from deposits and discoloration. Submit typewritten letter to inform Owner's Representative upon completion of the Work.

3.16 CLEANING STEAM HEATING SYSTEM

A. Waste returns to sewer until condensate is clean, but not more than 48 hours. Make and remove temporary pipe connections as required. Pipe to nearest waste point. Clean system until strainers are found clean. Temper with domestic water to keep waste below 140°F.

3.17 TESTS

A. Test piping and accessories before insulation, or concealment. Repeat as many times as necessary to prove tight system. Notify Owner's Representative at least seven days in advance of each test. Isolate valves and equipment not capable of withstanding test pressures. Make leaks tight; no caulking permitted. Remove and replace defective fittings, pipe or connections. Furnish necessary pumps, gauges, equipment, piping, valving, power and labor for testing. Certify that tests have been successfully completed.

B. Schedule of Test Requirements:

1. Hot, Chilled, Dual temp,Condenser,Domestic Water: Hydrostatic, 100 psig at high point of system; two (2) hours duration.

2. Refrigeration:

a. After installation, charge system with dry nitrogen to manufacturer's recommended pressure.

b. System shall hold this charge with no pressure drop for 24 hours.

3. Gas Piping: Test with air to a maximum test pressure of 50 psi for 2 in. and smaller piping, 30 psi for 2-1/2 in. and larger piping for two (2) hour duration and as required by local utility purveyor. Provide a pressure relief valve in the system set for 10 psi more than the test pressure.

4. Test: No change in pressure under stable temperature conditions.

5. Equipment: Test at working pressures.

3.18 PROTECTION AGAINST PHYSICAL DAMAGE

A. In concealed locations where piping, other than cast-iron or steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 in. from the nearest edge of the member, the pipe shall be protected by shield plates. Protective steel shield plates having a minimum thickness of 0.0575 in. (No. 16 gage) shall cover the area of the pipe where the member is notched or bored, and shall extend note less than 2 in. above sole plates and below top plates.

3.19 PIPE LINE SIZING

A. Pipe sizes called for are to be maintained. Pipe sizing changes made only as reviewed by Owner's Representative. Where discrepancy in size occurs, the larger size shall be provided.

EXHIBIT "A" - PIPING MATERIALS (HVAC)

(Notes are at end of Exhibit "A")

SERVICE	PIPE MATERIALS	FITTINGS	CONNECTIONS
Hot water heating and Dual Temp	Schedule 40, black steel	Malleable iron and butt weld	Screwed 2 in. and smaller; Welded 2-1/2 in. and larger; (SEE NOTE 1)
Hot water heating and Dual Temp (optional)	Schedule 40, black steel	Grooved, rigid couplings	Mechanical with gasket, 1-1/2 in. and larger (SEE NOTE 2)
Hot water heating and Dual Temp (optional)	Type L copper	Wrought copper or cast bronze, solder end	No-lead solder for 2 in. and smaller; 95/5 for 2-1/2 in. and larger
Hot water heating and Dual Temp (optional)	Type L copper	Wrought copper or cast bronze	Viega Pro-Press, Nibco Press, Elkhart Apolloxpress
Hot water heating and Dual Temp (optional)	Type L copper	Wrought copper or cast bronze	Mechanical with gasket, 1-1/2 in. and larger (SEE NOTE 2)
Chilled water	Schedule 40, black steel	Butt weld and malleable iron	2-1/2 in. and larger welded or flanged; 2 in. and smaller screwed (SEE NOTE 1)
Chilled water (optional)	Schedule 40, black steel	Grooved rigid couplings	Mechanical with gasket, 1-1/2 in. and larger (SEE NOTE 2)
Chilled water (optional)	Type L copper	Wrought copper or cast bronze solder end	No-lead solder for 2 in. and smaller 95/5 for 2-1/2 in. and larger
Chilled water (optional)	Type L copper	Wrought copper or cast bronze	Viega Pro-Press, Nibco Press, Elkhart Apolloxpress
Chilled water (optional)	Type L copper	Wrought copper or cast bronze	Mechanical with gasket, 1-1/2 in. and larger (SEE NOTE 2)
Refrigerant	Type L refrigerant grade hard temper, deoxidized copper	Wrought copper, solder end	Sil-Flo "5" silver brazing

SERVICE	PIPE MATERIALS	FITTINGS	CONNECTIONS
Vent, overflow, drain	Schedule 40, galvanized steel or Type M copper	Cast iron drainage type or wrought copper	Threaded or solder
Vent, overflow, drain (optional)	Schedule 40, galvanized steel or Type M copper	Grooved, rigid couplings	Victaulic mechanical coupling with gasket

NOTES FOR EXHIBIT "A":

NOTE 1: Screwed piping permitted in Crawl Spaces, Mechanical Rooms and Boiler Rooms.

NOTE 2: Grooved piping shall not be installed in shafts.

END OF SECTION

SECTION 232123 - PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services as required, for the complete installation designed in Contract Documents.

1.2 SUBMITTALS

A. Shop drawings and performance curves, on pumps and pump accessories clearly indicate which equipment is being submitted.

B. Provide catalog information on motors as specified in Section 230513.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Pumps shall be non-overloading over their entire performance range with motors capable of running continuously without undue noise, heating, or sparking. Impellers shall be statically and dynamically balanced. Provide mechanical seals for closed systems, constructed of carbon rings with ceramic mating seat up to 220°F. Provide packing type seals for open systems only. Provide materials suitable for water pressures, temperature and conditions for each application. Provide tapped discharges and suction connections for gauges, vent and drain. Provide factory trimmed impeller if required, to meet initial delivery requirements.

B. Provide the services of a factory service engineer or machinist to check each pump alignment before pump is started, using laser equipment.

2.2 SELECTION CRITERIA

A. Pumps shall be non-overloading over their entire performance ranges, with trimmed impeller as required to meet initial delivery requirements. Pump selection shall not take into account, or infringe on the service factor of the motor.

B. Select pumps at a point within the maximum efficiency for a given impeller casing construction. Deviations within 3 percent of maximum efficiency are permissible, provided that the lesser efficiency is not less than the scheduled efficiency.

C. Pumps may not be selected such that the impeller diameter is larger than 90 percent of the published maximum diameter for the casing using smaller equipment than the scheduled equipment.

2.3 IN-LINE CLOSE COUPLED

A. Designed for continuous operation between 40° and 225°F. Single stage, end suction with cast iron case constructed for 175 psi wp. Enclosed, bronze impeller mounted on a

hardened, alloy steel shaft, mounted with bronze sleeve bearings. Pump shall be direct connected to the drive motor by means of a flexible coupling.

B. Design Equipment: Bell & Gossett Series e-90.

C. Make: Armstrong, Bell & Gossett, Taco, Grundfos CBS/Paco, Wilo.

2.4 BASE MOUNTED END SUCTION TYPE

A. Designed for continuous operation between 40° and 225°. Single stage, end suction, bronze fitted, with cast iron volute for service to 175 psi wp. Enclosed bronze impeller mounted on a hardened, alloy steel shaft with regreasible ball bearings. Pump shall be direct connected to the drive motor by means of a rubber insert, flexible coupling with ANSI/OSHA guard. Pump and motor shall be mounted on a groutable structural steel main-frame with welded cross members. Pumps used in a variable speed pumping system shall contain couplings suitable for very low and intermittent torque loads.

B. Design Equipment: Bell & Gossett Series e-1510.

C. Acceptable Make: Armstrong, Bell & Gossett, Taco, Grundfos CBS, Paco LF, Patterson.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings and accessories.

B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

C. Provide 6 in. concrete pad for each base mounted pump. Level base so that pump and pump casing are not strained. Align pumps as directed by manufacturer. After pumps have been aligned, install dowels to prevent shifting. Fill base with non-shrink grout through grouting holes provided in baseplate. Contractor responsible for accurate size of base and exact location of mounting bolts. Contractor responsible for trouble resulting from poor pump alignment.

D. Base mounted end suction pumps shall be provided with inlet suction diffusers where shown on drawings. Pipe suction diffuser blow-off (full line size with ball valve) to nearest floor drain. Provide start-up strainers for first 48 hours of operation. Replace after completion of start-up period.

E. In-line pumps shall be installed using continuous-thread, hanger rods and elastomeric hangers of size required to support weight of in-line pumps.

F. Provide inertia bases as specified, determine exact height of bases required for base mounted elbows; shim to match mounting height of base elbow with inlet and outlet of pump. Refer to Specification Section 230548 for additional details.

3.2 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment services for all pumps that use a coupler attached to the device train, whether base mounted or inline mounted. Alignment shall be accomplished with a laser shaft alignment system.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

E. Provide an alignment report indicating alignment setup data, tolerances and final results.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Check piping connections for tightness.

3. Clean strainers on suction piping.

4. Perform the following startup checks for each pump before starting:

a. Verify bearing lubrication.

b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.

6. Start motor.

7. Open discharge valve slowly.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION

SECTION 233100 - SHEET METAL AND DUCTWORK ACCESSORIES CONSTRUCTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services required for the complete installation designed in Contract Documents.

1.2 QUALITY ASSURANCE

A. Ductwork shall be fabricated and installed in compliance with latest edition of the following standards.

1. SMACNA Duct Construction Standards - Metal and Flexible Ductwork.
2. SMACNA Duct Liner Application Standard.
3. SMACNA HVAC Air Duct Leakage Test Manual.
4. 2020 Energy Conservation Construction Code of New York State.
5. SMACNA Kitchen Ventilation and Food Service Equipment Fabrication and Installation Guidelines.
6. NFPA Standard 96.
7. Plans and Specifications which exceed the requirements in any of the referenced standards.
8. 2020 Mechanical Code of New York State.

B. All sheet metal shall be fabricated and installed by an experienced Contractor specializing in this type of work.

C. All ductwork and fittings shall have a computer generated label affixed to the exterior surface of each section, detailing all applicable information including the duct dimensions, gauge, reinforcement type/class and connection type by systems manufacturer. Galvanizing thickness shall be clearly stenciled on each duct section.

D. All ductwork on the project shall meet the SMACNA Duct Cleanliness For New Construction Guidelines, "Advanced Level" of duct cleanliness for production, delivery, storage and installation of ductwork.

1.3 SUBMITTALS

A. Ductwork Shop Drawings.

B. Duct Access Doors.

C. Flexible Duct.

D. Submit a complete shop standard manual including miscellaneous materials, and construction details for all shop fabricated materials including, but not limited to, volume dampers, turning vanes, duct sealant, equipment flexible connections, access doors, flexible duct, acoustical duct lining, etc.

1.4 GENERAL

A. All adhesives, sealants, primers and paint used for ductwork in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

1.5 DUCTWORK CLASSIFICATION

A. Duct systems are to be classified and constructed per the SMACNA Velocity-Pressure classification system as follows:

1. All ductwork shall be constructed for a minimum pressure class of 2 in. w.g. (unless stated otherwise) for the following systems, as applicable:

a. Supply duct downstream of terminal units.

b. Typical low pressure supply ductwork.

c. Typical return ductwork.

d. Typical low pressure exhaust ductwork.

2. Supply duct upstream of terminal units shall be constructed for a minimum pressure class of 3 in. w.g. unless otherwise stated or required as per below.

3. Pressure classes above 3 in. w.g. shall be provided as follows, based upon the external static pressure as scheduled for each specific fan.

Scheduled External Static Pressure	**Pressure Class**
Over 3 in. up to 4 in. w.g.	4 in. w.g.
Over 4 in. up to 6 in. w.g.	6 in. w.g.
Over 6 in. up to 10 in. w.g.	10 in. w.g.

1.6 DUCTWORK SHOP DRAWINGS

A. Prepare minimum 1/4 in. scale drawings:

1. Detailed ductwork shop drawings shall include size, layouts and pressure classifications. Any ductwork installed without benefit of review by the Engineer of Record may be subject to replacement at the expense of the Contractor.

2. Constructed from actual field inspections and measurements so as to assure a complete job.

3. Incorporate dimensions of actual equipment proposed for use on the project.

4. Showing adequate sections, elevations, and plan views and indicating the bottom of ductwork elevations from the finished floor.

5. Indicating all volume dampers, fire dampers, smoke dampers, damper access doors and other accessories required for a completed project.

B. Call to the attention of the Engineers immediately, any major deviations from the Contract Drawings, which must be made. All deviations shall be documented in writing.

C. Indicate roof, wall and floor opening dimensions and locations shown on shop drawings.

D. Submit prints to each Contractor of the other trades for review for interference's and coordination with their work.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Unless otherwise called for, provide materials in accordance with Exhibit I at the end of this section.

2.2 SQUARE AND RECTANGULAR DUCTWORK

A. Materials:

1. Galvanized Sheetmetal: Comply with ASTM A653 and A924, with G90/Z275 coating.

2. Stainless-steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in Exhibit "I"; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D or No. 3 as indicated in Exhibit "I".

3. Aluminum sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

4. Gauges per SMACNA HVAC Duct Construction Standards, Metal and Flexible.

B. Transverse and longitudinal duct seams reinforcement shall conform to appropriate tables and figures per SMACNA Velocity-Pressure Classification for duct construction.

1. Transverse joints shall be sealed with duct joint sealant. "Ductmate" or "Nexus" 4-bolt connection systems may be used in lieu of standard construction.

2. Field assembled longitudinal seams shall be sealed with duct sealant. Factory or shop fabricated rolled or machine pressed longitudinal seams does not require sealant.

C. Corner closures shall be required as described and illustrated by SMACNA Duct Construction Standards.

D. Throat radius on all elbows shall not be less than the dimension of the duct plane of radius. Where this cannot be maintained, use shorter radius with internal guide vanes, or square elbow with turning vanes.

E. Bracing and hanging of ductwork shall be per SMACNA Standards for size and system class of ductwork being used.

F. Any transformations shall not reduce the ductwork cross-sectional area. Maximum angle in straight duct, 20° for diverging flow and 30° for contraction flow. Transformation from square to round or flat to oval seams welded or brazed.

2.3 ROUND DUCTWORK

A. Standard Round Ductwork:

1. Materials:

a. Galvanized Sheetmetal: Comply with ASTM A653 and A924, with G90/Z275 coating.

b. Stainless-steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in Exhibit "I"; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D or No. 3 as indicated in Exhibit "I".

c. Aluminum sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

d. Gauges per SMACNA Duct Construction Standards. Spiral lock-seam or longitudinal fusion-welded.

2. All spiral ducts shall have locked seams so made as to eliminate leakage under pressure for which this system has been designed. Longitudinal seams duct shall have fusion-welded butt seams.

3. No stovepipe will be allowed.

4. Round Ductwork Fittings:

a. All fittings fabricated per SMACNA Standards for round and flat-oval ductwork, material to match straight pieces of ductwork.

b. Fittings shall have continuous, welded seams.

c. 90° tees shall be conical type. 90° tees and 45° laterals up to and including 12 in. diameter tap size shall have a radiused entrance into the

tap, produced by machine or press forming. The entrance shall be free of any restrictions.

d. Round taps off the bottom of rectangular ducts down to diffusers shall be made with a 45° square to round shoe-tap.

5. Elbows:

a. Diameters 3 in. through 8 in.: Two-section stamped and continuously welded elbows, material to match straight pieces of ductwork.

b. Over 8 in.: Gored construction with standing seam construction and internally sealed or continuously welded. Less than 35° - two gores, 36° to 70° - three gores, over 71° - five gores.

c. Fabricated to a centerline radius of 1.5 times the cross-section diameter.

6. Joints:

a. For duct construction pressure 3 in. w.g. or greater:

1) Round Joints:

a) Unexposed Duct 3 in. - 30 in. Diameter: Connect round duct with a one piece interior slip coupling, at least two gauges heavier than duct wall, beaded at center and fastener to duct with screws. Seal joint with an approved sealant applied continuously around both end of coupler prior to assembling and after fastening.

b) All Exposed Duct and Unexposed Duct 30 in. - 72 in. Diameter: Install using a three piece, gasket flanged-joint consisting of two internal flanges, with integral mastic sealant, and one external closure band, which compress the gasket between the internal flanges.

(1) Acceptable Manufacturer: Ductmate Industries "Spiralmate" system or approved equal.

c) Above 72 in. Diameter: Install using companion angle flanged joints as defined in Figure 3-1 of the 2005 SMACNA Manual, "HVAC Duct Construction Standards, Metal and Flexible" Third Edition. Refer to manual for proper sizing and construction details.

d) Dust collection systems and exposed duct 3 in. - 14 in. use a one piece, polyethylene lined gasket connector with integrated bolt for the closure system.

(1) Acceptable Manufacturer: Ductmate Industries "Quicksleeve" or approved equal.

b. Pipe-to-pipe joints in diameters up to 60 in. shall be by the use of sleeve couplings, reinforced by rolled beads.

c. Pipe-to-fitting joints in diameters up to 60 in. shall be by slip-fit of projecting collar of the fitting into the pipe.

d. Insertion length of sleeve coupling and fitting collar shall be 2 in. up to 36 in. diameter and 4 in. above 36 in. diameter.

e. Pipe-to-pipe and pipe-to-fitting connections in ductwork above 60 in. in diameter shall be made by angle ring flanges. The flange on the pipe shall be a 2 in. x 2 in. x 3/16 in. angle attached to the pipe with a continuous weld. The fittings shall have a loose ring "Van Stone" flange. A 5/8 in. flange shall be provided to act as a gasketing surface for sealing with the angle ring being a rolled, welded ring 2 in. x 2 in. x 3/16 in. Bolt hole spacing for angle rings shall be 6 in. centers.

f. If longitudinal seam duct greater than 60 in. in diameter is supplied in lengths greater than 4 ft., one angle ring must be welded to the duct on 4 ft. centers for support.

g. Clothes dryer exhaust duct connections shall be made with Ductmate Quick-Sleeve Round Duct Connector, or an approved equal, for use with round duct sizes ranging from 3 in. through 14 in. in diameter. The installation of the connector shall be in accordance with the manufacturer's instructions. The connector shall consist of galvanized metal sleeve, complete with fastening system to compress gasket. Sleeve will properly retain and compress gasket while providing rigidity to duct upon assembly. A polyethylene gasket shall have sufficient elasticity to accommodate the spiral duct seam.

2.4 DUCTWORK SEALING

A. SMACNA Duct Sealing Classification shall be used for duct systems using the following criteria:

1. Ductwork and all plenums with pressure class ratings shall be constructed to Seal Class A, as required to meet the requirements of SMACNA Duct Construction Standards and with standard industry practice, including transverse joints, longitudinal seams, fitting connections, and all penetrations of the duct wall.

2. Openings for rotating shafts shall be sealed with bushings or other devices that seal off air leakage. Pressure sensitive tape shall not be used.

3. All connections shall be sealed, including but not limited to spin-ins, taps, other branch connections, access doors, access panels and duct connections to equipment.

4. Sealing that would void product listings is not required.

5. Spiral lock seams need not be sealed.

B. Duct sealant for indoor applications shall be non-fibrated, water based, Hardcast Iron-Grip IG-601, Ductmate PRO Seal, Foster 32-17 or Childers CP146.

C. Duct sealant for outdoor applications shall be fibrated, water based, Hardcast Versa-Grip VG-102, Ductmate Fiberseal, Foster 32-17 or Childers CP148.

D. Sealants and tapes shall be listed and labeled in accordance with UL 181A or UL181B and marked according to type.

2.5 TURNING VANES

A. Provide in mitered elbows as shown on contract drawings. Vanes 36 in. or longer shall be double wall air foil type. All turning vanes shall be installed as per the latest SMACNA Standards. Turning vane size and spacing shall be as per SMACNA. Turning vane spacing greater than SMACNA Standards is not acceptable.

B. Turning vanes shall be Harper or equivalent double wall turning vanes fabricated from the same material as the duct.

C. Turning vane front and back panels shall be securely locked together with adequate crimping to prevent twisting of vane. Vane shall be capable of withstanding 250 pounds of tensile load when secured according to the manufacturer's instructions.

D. Rails for mounting turning vanes shall have self locking, friction fit tabs designed to facilitate proper alignment of vanes. Tab spacing shall be as specified in Figure 4-3 of the 2005 SMACNA Manual, "HVAC Duct Construction Standards, Metal and Flexible". Rail systems with non-compliant tab spacing shall not be accepted.

E. Acoustical Turning Vane: Shall be used in applications that require quiet operating systems. Mounting rails shall have friction insert tabs that align the vanes automatically.

F. Acceptable Manufacturer: Ductmate Industries PRO-Rail Turning Vane or approved equal.

2.6 DAMPERS IN DUCTWORK

A. Blade Type Volume Dampers: Constructed per SMACNA, one gauge heavier than duct material, securely fastened to 3/8 in. sq., cold rolled steel operator rod. Provide Ventlock 639 elevated dial regulator for 2 in. insulated ductwork.

B. Multiple Blade Type Volume Dampers: Provide multiple blade volume dampers in ductwork above 12 in. in height.

1. Heavy duty, manual balancing dampers suitable for application in HVAC systems with velocities to 1,500 ft. per minute, open position and max. pressure of 3 in. w.g. close position. Ruskin MD 35 or equivalent.

2. Fabrication:

a. Frame: 5 in. x minimum 16 gauge roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gauge U-channel.

3. Blades:

a. Style: Single skin with 3 longitudinal grooves.

b. Action: Parallel

c. Orientation: Horizontal

d. Material: Minimum 16 gauge equivalent thickness, galvanized steel.

e. Width: Nominal 6 in.

4. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.

5. Linkage: Concealed in frame.

6. Axles: Minimum 1/2 in. diameter, plated steel, hex-shaped, mechanically attached to blade.

7. Control Shaft: 3/8 in. square plated steel.

8. Finish: Mill galvanized.

a. Actuator: Hand quadrant for 3/8 in. square extended shaft.

b. Hand Quadrant Standoff Bracket: 2 in. standoff for insulated ductwork.

c. Oillite bearings.

d. Factory Sleeve: Minimum 20 gauge thickness, minimum 12 in. length.

C. Fire Dampers: See "Fire Dampers" Section.

D. Automatic Air Dampers: Furnished as part of "Building Management System" Section 230923 and installed by this Contractor.

2.7 FLEXIBLE AIR DUCTS AND CONNECTORS

A. Flexible air ducts and connectors shall be constructed in compliance with NFPA Bulletin 90A, 90B and UL Standard 181 and shall be listed and labeled as Class I Air Duct.

B. Flexible air ducts and connectors shall be tri-laminate:

1. Consisting of corrosion resistant galvanized steel helix encapsulated by a double lamination of polyethylene or spun bond nylon.

2. Factory applied (R 6.0) fiberglass exterior insulation, sheathed in a seamless, tri-directionally reinforced, metalized polyester, exterior vapor barrier.

3. R-value shall be classified by Underwriters Laboratories, and certified by the Air Diffusion Council, in accordance with ADC Flexible Duct Performance and Installation Standard (1991), using ASTM C-518, at installed wall thickness, on flat insulation only. Comply with ASHRAE/IESNA 90.1.

4. Recommended operating pressure for flexible ductwork shall be three times maximum system press but not less than 6 in. w.g. positive pressure for 4 in. - 20 in. dia., 5 in. wg. negative pressure through 16 in. dia., 1 in. negative pressure for 18 in. and 20 in. dia. Maximum velocity of 5500 fpm.

5. Operating temperature range - 20°F to 250°F, intermittent @1/2 in. pos. w.g. max., -20°F to 140°F, continuous at maximum pressure.

6. Flame Spread: 25 max. smoke developed rating: 50 max.

7. Porous inner core flexible duct shall not be used.

C. Static pressure and thermal performance shall be tested and certified in accordance with Air Diffusion Council (ADC) Test Code FD-72-R1 under conditions of 140°F for 164 hours and 180°F for 4 hours.

D. Acoustical performance shall be certified in accordance with ASTM E 477 and/or Air Diffusion Council Test Code FD-72-R1.

1. Minimum Acoustic Performance:

a. The insertion loss (dB) of a 6 foot length of duct when tested in accordance with ASTM E477 at a velocity of 1000 feet per minute shall be at least:

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
8 inch dia.	26	27	27	31	32	27
12 inch dia	22	26	24	31	31	20

E. Friction loss and leakage for flexible duct only shall be certified in accordance with Air Diffusion Council Test Code FD-72-R1. Leakage for connections shall be accordance with UL 181 requirements.

F. Basis-of-Design: Flexmaster 6B (R-6.0)

G. Acceptable Manufacturers:

1. Dundas-Jafine Type SPC R6.0.

2. Hart & Cooley Type F216 (R-6.0) Flexible Technologies, Inc. Thermaflex Type M-KE (R-6.0).

3. Atco Rubber Products, Inc. Type 036 (R-6.0).

2.8 FLEXIBLE DUCT ELBOW SUPPORT

A. Provide flexible duct elbow support for flexible duct connected directly to a diffuser collar.

B. Elbow support shall be a radius forming brace designed to form flexible duct into a 90° elbow not less than one duct diameter in centerline radius.

C. Elbow support shall be manufactured from 100% recycled copolymer polypropylene with a universal fit of 4 in. thru 16 in. and be UL listed.

D. Basis-of-Design: Titus Flexright.

2.9 FLEXIBLE CONNECTIONS TO FANS AND EQUIPMENT

A. Basis of Deign: Ventfabrics, Inc.

B. Acceptable Manufacturers: Ductmate Industries, Inc., Duro Dyne Inc., Elgen Manufacturing, Ward Industries, Inc.; a division of Hart & Cooley, Inc.

C. Materials: Flame-retardant or noncombustible fabrics, water and mildew resistant UL Standard 214.

D. Coatings and Adhesives: Comply with UL 181, Class 1.

E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 in.wide attached to two (2) strips of 2-3/4-in. wide, 0.028-in. thick, galvanized sheet steel or 0.032 in. thick aluminum sheets. Provide metal compatible with connected ducts.

F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.

2. Tensile Strength: 480 lbf/in. in the warp and 360 lbf/in. in the filling.

3. Service Temperature: Minus 40 to plus 200°F.

G. 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.

2. Tensile Strength: 530 lbf/in. in the warp and 440 lbf/in. in the filling.

3. Service Temperature: Minus 50 to plus 250°F.

H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-in. movement at start and stop.

2.10 ACCESS DOORS

A. General:

1. Provide access doors of adequate size to allow easy access to the equipment that will require maintenance. Provide insulated or acoustically lined doors to prevent condensation where applicable.

2. Manufacturer to provide an installed neoprene gasket around perimeter of access door for airtight seal.

3. Systems 3 in. w.g. or less shall utilize a hinged, cam, or hinged and cam square framed access door.

4. Systems 4 in. w.g. and above shall utilize a sandwich type access door. Construct doors in accordance with Figure 7-3 of the 2005 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible" Third Edition.

5. Approved Manufacturer: Ductmate Industries "Sandwich" style door or approved equal.

6. All access doors shall be continuous piano hinged type, unless noted otherwise.

7. Non-hinged only allowed where clearance to ceiling does not allow a full 90° swing.

8. Double panel insulated type when used in insulated duct.

9. Single panel uninsulated type allowed in un-insulated duct.

10. Pressure rated according to system in which being installed. Door-to-frame and frame-to-duct gasketing.

11. Provide specified Seal Class A or B ductwork sealing around frame, and hand adjust the latch tension for proper seal, on all access doors other than sandwich panel (Ductmate) style.

12. MINIMUM access door size for ducts 12 in. or less in depth is 12 in. x 8 in.

13. MINIMUM access door size for ducts 12 in. to 18 in. in depth is 18 in. x 14 in.

14. MINIMUM access door size for ducts more than 18 in. in depth is 24 in. x 18 in.

15. In ducts which require multiple section fire dampers due to duct size, provide one access door for each fire damper section.

16. Access doors for fire and smoke dampers shall be permanently labeled with 1/2 in. high lettering reading "SMOKE DAMPER" or "FIRE DAMPER".

17. Grease exhaust duct doors shall be grease and air tight, UL 1978 listed, meet NFPA 96 standards and all mechanical codes. Grease duct access doors can be sandwich type or with a weld on frame, with/without hinge. Approved Manufacturer: Ductmate Industries "Ultimate" style door or approved equal.

18. All grease duct access doors used must be accompanied by independent testing in conjunction with each manufacturer's respective wrap system for high temperature applications.

B. Door Types:

1. Low Pressure Systems (2 in. w.g. pressure class): National Controlled Air ADH-1, Ruskin ADH22, Vent Products 9701, Air Balance FSA-100, Safe Air SAH, Nailor.

2. Medium and High Pressure Systems (3 in. w.g. pressure class and higher):

a. Rectangular Duct: Ductmate Industries "Ultimate" Style Door, or equal.

b. Round Duct: Ductmate Industries Round Sandwich type, or equal. 8 in. x 4 in. for ducts 14 in. and less in diameter. Ductmate Industries Round Sandwich type 16 in. x 12 in. for ducts more than 14 in. in diameter.

c. Furnish and install factory supplied protector molding on cut medal edge for all Ductmate access doors.

3. Kitchen Hood Exhaust Systems: In accordance with the latest requirements of NFPA 96, grease-tight, flanged and bolted. Approved Manufacturer: Ductmate Industries "Ultimate" style door or approved equal.

2.11 BOILER BREECHINGS AND FLUES

A. Gauges, reinforcing and other features shall not be less than required by SMACNA.

B. Flanged at boiler connections. Allow for expansion.

C. Furnish ten gauge black steel sleeves and coordinate installation at stack openings with other trades. Caulk space between breeching and stack sleeve gastight with fireproof rope.

D. Provide cleanout doors at end of breeching and adjacent to stack as shown on drawings.

E. Fireproof gaskets at joints and cleanouts.

2.12 EXHAUST HOODS AND HOOD CONNECTIONS

A. General Requirements:

1. Provide hoods and/or duct connections to hoods/fans where furnished by others.

2. Duct material, thickness and joints as required for gases and vapors involved and per SMACNA.

3. Clearance between bottom of hood and floor shall be 78 in.

4. Provide continuous internal channel brackets for supporting lighting fixtures, coordinate with and install to suit Division 26 "Electrical".

B. Kitchen Hood Duct Connections:

1. Exposed duct shall be 304 stainless steel, #3 polish finish, welded construction.

2. Concealed duct shall be black steel, welded, flanged and gasketed.

3. Metal gauges comparable to similar duct sizes with adequate stiffening, 16 gauge minimum thickness.

4. Support from building structural members.

C. Dishwasher Hood:

1. Hood and exposed duct shall be 304 stainless steel, #3 polished finish, welded construction.

2. Install butterfly damper near each opening with operator Ventlok #688.

3. Exposed vertical duct, with stainless steel, escutcheon at ceiling, and stainless steel angle flange at hood.

4. Exact duct configuration and location as required for machine as finally installed.

2.13 ACOUSTIC-THERMAL DUCT LINING IN DUCTWORK

A. General: Comply with NFPA Standard 90 and NAIMA Standard AHC-101.

B. Materials: ASTM C 1071, Type I. Glass mineral wool insulation coated with an anti-microbial EPA registered coating that seals the airstream surface fibers into a smooth,

low-friction surface acoustic ductliner shall be of thickness shown in the table. Density at 1.5 PCF. Maximum "K" value to be 0.24 btu/in. /sq. ft. /degrees F. /hr. when tested in accordance to ASTM C177. Acoustic duct liner to be suitable for use up to 6000 feet per minute air velocity and temperatures up to 250°F. The acoustic duct liner shall not accelerate the corrosion of steel, copper or aluminum. The liner shall not absorb greater than 3% by weight when tested per ASTM C1104. Acoustic duct liner shall provide the minimum sound absorption coefficients shown below when tested per ASTM C423 and ASTM E795, Mounting Type A.

OCTAVE BAND FREQUENCIES HZ							
Thickness	**125**	**250**	**500**	**1000**	**2000**	**4000**	**NRC**
1-1/2 in.	.23	.50	.87	.92	.93	.93	.80
2 in.	.37	.76	1.02	1.00	.98	.92	.95

C. Thickness: Unless otherwise noted, all supply air ductwork indicated to be acoustically lined, shall have 1-1/2 in. thick liner with a minimum R value of 6. Return or exhaust ductwork, if acoustically lined, shall be of a thickness specifically noted. Note that per the symbol list (L) equals 1-1/2 in. thick. If called for on the plans, (2L) equals 2 in. thick.

D. Fire Hazard Classification: Flame spread rating of not more than 25 and a smoke developed rating of no higher than 50, when tested in accordance with ASTM E84, UL 723, UL/ULC S102-M88 and NFPA 255.

E. Liner Adhesive: Comply with NFPA Standard 90A, ASTM C919, and maximum VOC requirements of LEED EQ 4.1 and EQ 4.2.

F. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct. Provide fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50 pound tensile dead load test perpendicular to the duct wall.

1. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.

2. Adhesive for Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

G. Design Equipment: Knauf Atmosphere.

H. Acceptable Makes: Knauf Atmosphere, Certainteed ToughGard R.

OCTAVE BAND FREQUENCIES HZ							
Thickness	**125**	**250**	**500**	**1000**	**2000**	**4000**	**NRC**
1-1/2 in.	.10	.47	.85	1.01	1.02	.99	.85
2 in.	.25	.66	1.00	1.05	1.02	1.01	.95

I. For duct velocities above 4000 fpm, provide metal "build-outs" of proper height, welded to the ductwork for turning vanes and dampers.

2.14 CABLE SUSPENSION SYSTEM

A. Ductwork not required to be exterior insulated in exposed installations may be installed using a cable suspension system.

B. Ductwork shall be installed using load rated, stainless steel cable suspension systems. Cables shall be pre-cut lengths, type 316 stainless steel with fused ends, and pre-made end attachments.

C. Cable grips shall be of 316 stainless steel and have an internal tamperproof cable release mechanism.

D. Stress distribution saddles shall be prescribed in addition for the support of rectangular duct on corners as necessary.

E. Hangers shall have a manufacturer's published safe working load and have a 5 to 1 safety factor.

F. Hang and support ductwork as defined in the latest edition of SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible".

G. Adjustable steel cable hanging system consisting of spring loaded, serrated clamping mechanism shall be tested and certified in compliance with all applicable SMACNA standards for upper and lower attachment methods.

1. All approved systems must be installed using matching components including steel cable, clamping mechanism and hardware approved by the manufacturer for its corresponding load rating. No Substitution of manufacturer's components is permitted.

2. Approved systems must be installed per the manufacturer's specific instructions and must not exceed the stated working load rating at any point throughout the system.

H. Supports, bar/angle reinforcements, and other products that are not part of the duct that are manufactured of uncoated mild steel shall either be painted with two (2) coats of primer or shall be manufactured of a galvanized equivalent material.

I. Approved Manufacturer: Ductmate Industries "Clutcher" Cable Hanging System or Gripple Inc.

2.15 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. Ventlock 699 or 699-2 based upon insulation thickness.

C. Install duct test holes where required for duct traverse testing and balancing purposes.

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. Equipment and systems shall be installed in accordance with local and state codes and regulations having jurisdiction. Bracing and hanging of ductwork shall be per SMACNA - HVAC Duct Construction Standard

B. Install all ductwork concealed and tight to the structure above unless noted otherwise on shop drawings. Fabricate only after the approval of shop drawings, and in locations to avoid interferences. Ductwork installed without approved shop drawings, which requires removal/modification and/or reinstallation due to conflicts or improper installation shall be repaired at no cost to the Owner.

C. Sizes given on contract drawings are inside dimensions.

D. Keep openings continuously closed and sealed with protective plastic wrapping during construction to prevent entrance of dirt and debris.

E. Extend access openings, damper rods and levers, to outside of external insulation make systems airtight.

F. No piping, conduit or other obstruction to airflow is permitted in ductwork.

G. Provide necessary openings, hanger inserts, framing, chases, and recesses, not provided by other trades.

H. Exposed exhaust or return registers and grilles shall be flush with face of duct; exposed supply registers and grilles shall be mounted outside airstream with 45° shoe-tap extension collars.

I. Provide 14 gauge sleeves for ducts passing through Mechanical Room floors. Set sleeves 4 in. above finished floor in Mechanical Rooms, seal watertight to floor.

J. Where a return or exhaust duct is shown to be left open ended, provide hardware mesh screen at opening.

K. Do not utilize flexible ductwork or connection in any way to connect variable or constant volume boxes to ductwork.

L. For duct penetrations of non-rated walls, provide sheet metal angle framing or sheet metal closure panels around the entire perimeter of each duct wall penetration on both sides of the wall, where the gap exceeds 1/4 inch. Where the gap is less than 1/4 inch, the gap may be caulked on both sides of the wall. Non-rated wall penetrations SHALL NOT be fire caulked under any circumstances.

M. For duct penetrations of rated walls, see Specification Section 230500 - Basic Mechanical and Electrical Requirements.

N. Ductwork that is called for to be welded shall be fully welded, continuous around the entire perimeter at all joints/seams, and shall be fully airtight and watertight.

3.2 FLEXIBLE CONNECTIONS

A. Provide flexible connections for the intake and discharge connections of duct connected to fans and air handling equipment.

B. Round connections are to be made with adhesive and metal drawbands with ends tightly bolted.

C. Rectangular connections shall be made with material securely held in grooved seam between flanges. Attach with adhesive and mechanical fasteners on 6 in. centers.

D. Connections shall be made with a minimum of 2 in. space between duct and equipment collars, installed in line, and with 1 in. excess material folded so as not to interfere with airflow through connection.

E. Mechanically fastened and sealed, with specified duct sealant, at duct and equipment connections.

3.3 FLEXIBLE AIR DUCTS AND CONNECTORS

A. "Air duct" applies to conduit or passageway for conveying air to or from heating, cooling, air conditioning or ventilating equipment but not including the plenum as defined in NFPA 90A. "Air connector" applies to conduit for transferring air between an air duct or plenum and an air terminal device or an air inlet or an air outlet as defined by the NFPA 90A.

B. For round to oval connections, provide round-oval flexible adapter.

C. Flexible air ducts and connectors shall be provided in fully extended condition, free from kinks.

D. Flexible air ducts and connectors shall not be used in systems with entering air temperatures in excess of 250°F.

E. Flexible air ducts and connectors shall use only the minimum length required to make the connection and shall be installed in the horizontal or vertical position. Flexible elbows are not acceptable. Do not exceed a maximum length of 48 in., fully extended.

F. Flexible air ducts and connectors shall use minimum 1/2 in. wide positive locking, steel worm drive clamp, or nylon plenum rated straps for joints and connections. One clamp or strap for the inside core liner and one clamp or strap for the outer jacketing. When non-metallic (nylon) straps are used, they should be listed and labeled to standard UL 181B. Fastener package should be marked UL 181 B-C.

G. Collars to which flexible duct is attached shall be beaded and a minimum of 2 in. in length. Wrap twice with UL 181 tape and secure with clamp or strap. Sleeves used for joining two sections of flexible duct shall be beaded and a minimum of 4 in. in length. The draw band shall be positioned behind the bead on the metal collar.

H. Outer vapor barrier and insulation shall be slid over inner core and collar, wrapped twice with UL 151 tape and secured with a clamp or strap.

I. Connections shall be per SMACNA "HVAC Duct Construction Standards - Metal and Flexible", Air Diffusion Council "Flexible Duct Performance and Installation Standards" and NAIMA Installation Standards.

J. Flexible duct shall be supported at manufacturer's recommended intervals, but no greater distance than 2'-6" on center and prior to all 90 degree bends. Maximum permissible sag shall be 1/2 in. per foot of support spacing. Provide a minimum of one hanger on each run of flexible duct.

K. A connection to rigid duct or equipment shall be considered a support joint. Long horizontal duct runs with sharp bends shall have additional supports before and after the bend approximately one duct diameter from the centerline of the bend.

L. Hanger or saddle material in contact with the flexible duct shall be of sufficient width to prevent any restriction of the internal diameter of the duct when the weight of the supported section rests on the hanger or saddle material. In no case shall the material contacting the flexible duct be less than 1-1/2 in. wide. Factory installed suspension systems integral to the flexible duct are an acceptable alternative hanging method when the manufacturer's recommended procedures are followed.

M. The hanger shall be strapped around the flexible duct and secured to the structure above. Hangers shall not be attached to other mechanical or electrical objects. Hangers may be attached to an approved trapeze. Ceiling grid shall not be used to fabricate a trapeze. Support hangers shall be installed horizontal. Screws shall not be used to penetrate the flexible duct to attach to the hanger.

N. Provide flexible duct connections and splices in accordance with manufacturer's recommended installation instructions.

O. Seal flexible duct connections with sealing materials listed and labeled in accordance with UL 181B. Mechanically secure connections with approved clamping materials.

3.4 TURNING VANES

A. Install only in square elbows of equal dimensions.

B. Install as per latest SMACNA Standards.

C. Secure vane runners to duct with spot welding, riveting or sheet metal screws.

D. When installing in ductwork with internal insulation.

1. Install runners in ductwork inside insulation and bolt through insulation and duct sides, welding bolts to insure rigid installation. Provide build-outs for duct Velocity-Pressure classes above 2 in. w.g.

3.5 DUCT CLEANLINESS AND CLEANING AFTER INSTALLATION

A. Duct Cleanliness:

1. All ductwork on the project shall meet the SMACNA Duct Cleanliness For New Construction Guidelines, "Advanced Level" of duct cleanliness for production, delivery, storage and installation of ductwork.

2. Prior to shipment to the jobsite, all duct ends and openings must be covered with a heavy duty, dual-ply, clear polyethylene protective film. Open ends are to be kept covered during transport, storage, and installation. As ductwork is installed at the job site, open ends are to be covered to maintain cleanliness.

3. The film must be securely affixed to protect against dirt and debris, and must be translucent to facilitate inspection of interior surfaces without removing the film. The film is have a elongation rating of 600% and a break strength of 13.1 lbs./in. The film shall contain no VOC's, and shall leave no residue on duct after removal.

4. Manufacturer: Ductmate Industries ProGuard (heavy duty grade clear).

B. Cleaning After Installation:

1. Interior surfaces shall be free of dust and debris prior to initial start up. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes. Any cleaning of duct systems shall comply with recommendations of NAIMA and NADCA.

2. Clean external surfaces of foreign substances that might cause corrosion, deterioration of the metal, or where ductwork is to be painted.

3. Clean debris from system before fans are turned on.

4. Keep openings continuously closed during the construction period.

5. Pay damages resulting from dirt blown on painted or other finished surfaces.

6. Repair or replace damaged fan wheels, dampers, or other system parts damaged as a result of debris.

7. Clean system as many times as required until the entire system is dirt free.

3.6 INSTALLATION OF ROUND DUCTWORK

A. Use factory-fabricated couplings for joints.

B. After the joint is slipped together, sheet metal screws are placed 1/2 in. from the joint bead for mechanical strength.

C. Sealer is applied to the outside of the joint and covering the screw heads.

D. Flanged joints shall be made with neoprene rubber gaskets.

3.7 TEST OF DUCTWORK

A. Conduct duct leakage tests per SMACNA "HVAC Air Duct Leakage Test Manual" and per the requirements of the 2020 Energy Conservation Construction Code of New York State, for all ductwork systems designed to operate at static pressures of 3.0 in. w.g. or greater. Representative sections totaling no less than 25% of the total duct area, per system, for the designated pressure class shall be tested as well as all associated ductwork located out-of-doors. All areas shall be as selected by the Engineer. Positive pressure leakage testing is acceptable for negative pressure ductwork. The rate of air leakage (CL) must be less than or equal to 4.0, as determined by equation 4 - 8 in 2020 ECCCNYS, which reads: $CL=F/P^{0.65}$ where F = measured leakage rate in CFM per 100 sq. ft. of duct surface, and P = static pressure of the test. When leakage above stated limits occurs, ascertain location of leaks and repair as required. Repeat tests as required to obtain allowable leakage rates. Prepare a report similar to that suggested by SMACNA and submit for review. Duct testing shall be conducted in the presence of the Owner's Representative.

B. Provide test reports indicating pressure tests performed. Include date, section tested, test pressure and leakage rate.

C. Ductwork not required to be tested for leakage, shall be checked and guaranteed to meet the standards of the specified SMACNA Duct Seal Class A. Air balancing and testing shall be used to determine satisfactory operation of duct systems. Balancing reports indicating excessive leakage amounts shall be required to rebuild, repair or seal ductwork having excessive leakage.

3.8 DAMPERS AND AIR CONTROL DEVICES

A. Provide volume dampers at all air outlets, diffusers, grilles and as noted on plans. Provide volume dampers at all low pressure supply, return and exhaust, branch ducts and as noted on the plans.

B. Provide dampers necessary to permit proper balancing of air quantities. Comply with code requirements for smoke and fire control. Prevent introduction of uncontrolled outside air into building through roof and wall openings.

C. When dampers are installed in acoustically lined ductwork, install with insulated "build-outs" per SMACNA.

D. Install fire dampers in accordance with "Fire Dampers" Section and applicable codes.

E. Install all dampers furnished as part of "Building Management System" Section.

3.9 ACCESS DOORS

A. Provide for access to upstream side of duct mounted reheat coils, dampers, damper motors, fire dampers, smoke dampers, smoke detectors, control devices, fan bearings, and

equipment requiring periodic inspection or service. Provide labels for fire and smoke dampers as called for in Part 2 - Products.

B. For ducts that are too small to install an access door of the minimum specified size, provide a 12 in. long section of removable ductwork for maintenance and inspection access. Removable ductwork shall be fastened between device requiring access and next duct section with duct flanges or Donaldson Torit clamp with PVC foam seal. For ducts that are required to be insulated, provisions shall be made to allow insulation to be easily removed and re-installed.

C. Provide access service openings as required by NFPA 96 at 20 ft. intervals along horizontal ducts and at each vertical riser for kitchen hood exhaust.

3.10 DUCT SUPPORTS

A. Provide per SMACNA, same material as duct. Hanger bands to extend down sides and turn under bottom 2 in. Minimum two metal screws per hanger. Angle iron on larger duct spaced per building structural system but not greater that 8 ft. Provide extra support angles as required.

B. Provide additional supports as required to support reheat coils, air terminal units, filter enclosures, and any other duct mounted equipment independent from the associated ductwork system.

3.11 AIR AND WATERTIGHT DUCTWORK

A. Where water and snow may accumulate on ductwork or where odors or corrosive gasses may collect, ductwork and plenums shall be made watertight by soldering, brazing or welding of joints. Grade ducts down toward waste points and/or toward louvers. Provide valve and drain piping from low point to waste point.

1. Kitchen hood exhaust ductwork.

2. Dishwasher hood and exhaust ductwork.

3. Shower room exhaust ductwork.

4. Intake and exhaust plenums.

5. Dryer exhaust ductwork.

B. Test for Water tightness: Before concealment, apply water by hose to check for leaks, witnessed by Owner's Representative.

3.12 BOILER BREECHINGS AND FLUES

A. Pitch upward and install in accordance with fuel burning equipment manufacturer's written instructions.

B. Provide barometric damper and other accessories in accordance with fuel burning equipment manufacturer's written instructions.

3.13 ACOUSTIC-THERMAL DUCT LINING

A. Increase metal duct dimensions to accommodate lining. Adhere lining to interior side of duct; minimum 90% coverage of Benjamin Foster 85-20 fire retardant adhesive, UL approved. Stapling method of attaching will not be permitted. Mechanical fasteners shall not pierce the sheet metal. Installing fasteners with spacing as per SMACNA Standards. Multiple layers of liner to achieve indicated thickness is prohibited.

B. Abutting edges of acoustic linings shall be sealed with a fire resistant neoprene coating, and exposed edges of acoustic linings shall be installed with sheet metal nosing to prevent erosion.

C. Lining shall not impart odor to the air, delaminate or be loosened by the airstream under normal operating conditions. Lining which is damaged during fabrication or shipment shall not be installed.

D. Supply ductwork downstream of terminal units shall have 1-1/2 in. thick acoustical lining for a minimum of 8feet. All air outlets shall be installed downstream of this minimum distance.

E. Provide 1-1/2 in. thick acoustical lining for a minimum of 10feet upstream and downstream of all supply and return fans.

3.14 SMOKE DETECTION

A. Smoke detectors shall be furnished by Division 26 "Electrical". This Contractor shall install detectors located in ductwork. Clearly indicate locations of smoke detectors on the sheet metal shop drawings.

B. Increase duct size at smoke detectors, where required for proper installation, per smoke detector manufacturer's recommendations. Coordinate minimum duct size required with Division 26 "Electrical".

3.15 RESIDENTIAL TYPE CLOTHES DRYER EXHAUST DUCTWORK AND LAUNDRY ROOMS IN RESIDENTIAL BUILDINGS

A. There shall be no fasteners of any kind protruding into the duct airstream.

B. Flexible ducts (code defined as transition ducts) used to connect the dryer to the exhaust duct system shall be metal, and shall be a single length that is listed and labeled for such use, in accordance with UL 2158A. The length of the transition duct shall not exceed 48 in.

C. Provide a UL classified dryer transition connection receptacle for recessed mounting in the wall behind each dryer. For a 4 in. stud wall, provide a Dryerbox Model DB-350 with an oval top duct connection opening. For a 6 in. stud wall or an 8 in. concrete block wall, provide a Dryerbox Model DB-425 with a 4 in. round top duct connection opening. Install per the manufacturers recommendations.

D. The maximum length of the clothes dryer exhaust duct shall not exceed 35 equivalent ft. from the connection to the transition duct from the dryer, to the outlet terminal. The maximum length shall be reduced for the fittings used per the applicable code. The maximum length does not include the transition duct.

E. Where the dryer exhaust duct system is concealed within the building construction, the total equivalent length of the exhaust duct shall be identified on a permanently mounted placard similar to below, as illustrated in International Mechanical Code Commentary.

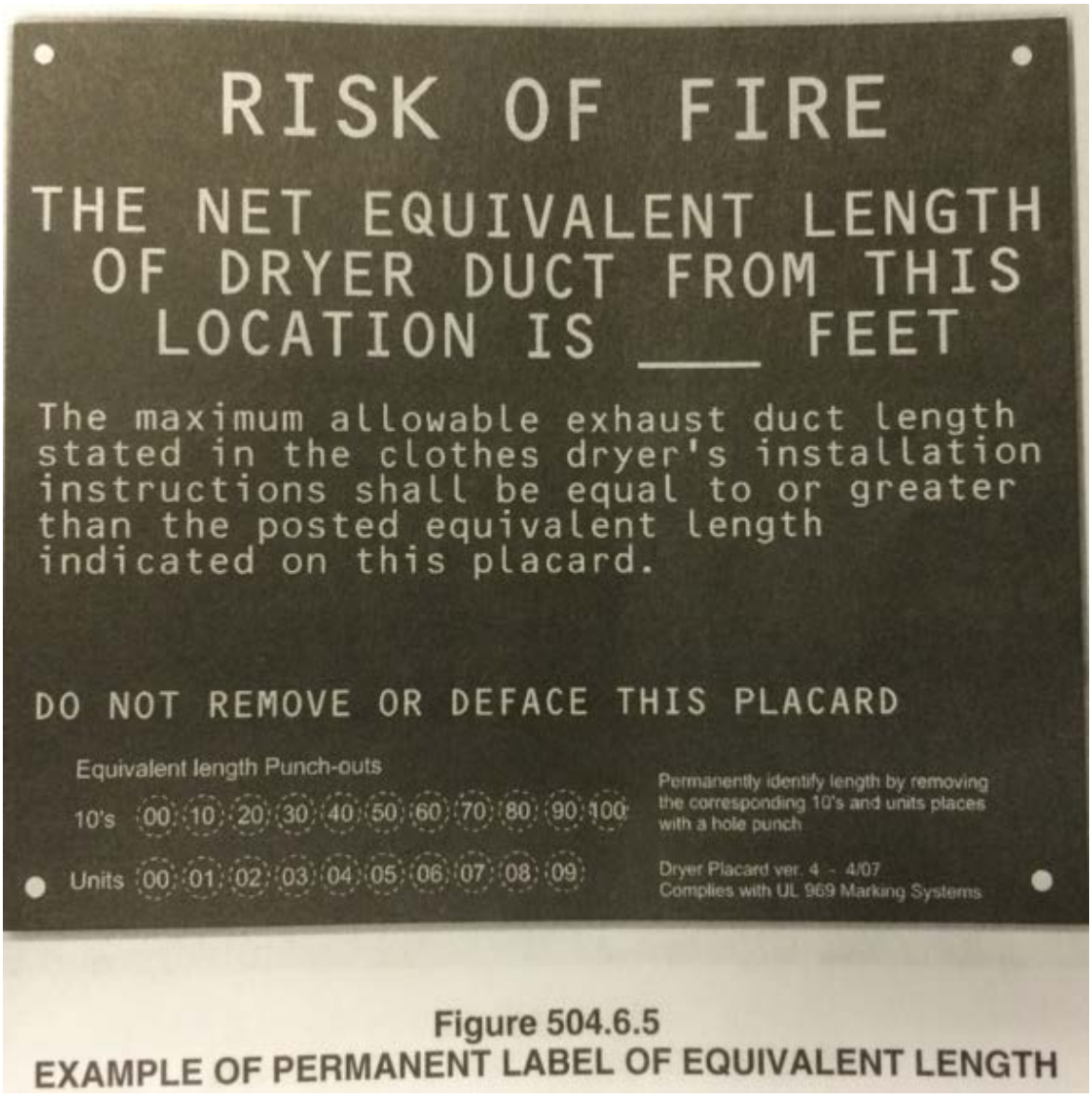


Figure 504.6.5
EXAMPLE OF PERMANENT LABEL OF EQUIVALENT LENGTH

F. Protective plates shall be placed where nails or screws from finish work are likely to penetrate the clothes dryer exhaust ductwork. Shield plates shall be placed on the finished face of all framing members where there is less than 1-1/4 in. between the duct and the finished face of the framing member. Protective shield plates shall be constructed of 0.062 in. (16 gauge) and extend a minimum of 2 in. above the framing sole plates and below the framing top plates.

G. Provide metal wall cap exhaust outlets and roof jack exhaust outlets for dryer venting as called for in the Contract Documents.

1. Wall cap clothes dryer outlets shall be 4 in. Lambro Model 281, aluminum vent with tailpiece, trim plate, UL listed flexible transition duct, and galvanized tension clamps, or approved equal.

2. Roof jack clothes dryer outlets for sloped roofs shall be Dryer Jack Model 486 (Extra Clearance Unit), constructed of 26 gauge galvalume with nailing flange, backdraft damper and factory powder coat finish (available in brown, white and black), or equal. Color selection by the architect.

3. Flat roof clothes dryer outlets shall be Dryer Jack Model DKU486U (flat roof model), constructed of 26 gauge galvalume, with 4 inch dryer vent connection, integral backdraft damper, 2.75 inch turned down perimeter flashing color with spot welded corners for use with a roof curb. Provide an 18 inch high roof curb conforming to the requirements of specification Section 230530.

3.16 DUCT SEALING

A. Preparation:

1. Clean surfaces of dirt, oil, grease and loose of foreign matter that could impair adhesion, using soap and water or solvent.

2. Allow surfaces to dry completely before proceeding.

B. Installation of Sealant System:

1. Apply sealant system to duct joints, fasteners, and seams in accordance with manufacturer's instructions.

2. Apply sealant by brush, putty knife or caulk gun, to full coverage. Remove excess adhesive immediately.

3. Completely seal duct joint, fasteners and seams without voids, to a minimum 20 mil thick wet film.

4. Apply and store at ambient temperature of 40°F to 100°F; and protect from freezing until dry.

C. Field Quality Control:

1. Allow duct sealant system to cure a minimum of 72 hours before operating the system.

2. Do not apply external duct insulation or coatings until the joints have been inspected by the Owner's Representative.

EXHIBIT I - DUCTWORK MATERIALS

SERVICE	MATERIAL	SPECIAL REQUIREMENTS
Supply, return, vent, relief, outside and exhaust	Lock forming quality, galvanized steel ASTM A653 and A924, galvaneal/paint grip if not insulated and exposed	Joints and features as called for
Exterior double wall ductwork	Pre-manufactured galvanized steel, double wall, 3 in. insulation between walls, solid inner liner with thickness per SMACNA, outer duct one gauge heavier. McGill Airflow LLC, or similar.	Horizontal top surfaces cross-broken for positive water drainage where shown as rectangular, Ductmate joints, seal Class A, and outdoor duct sealant applied per spec, watertight construction.
Exterior ductwork	Galvaneal/paint grip (ready for paint) if not insulated, otherwise same as above	Horizontal top surfaces crossbrocken for positive water drainage, Ductmate joints, seal Class A, and outdoor duct sealant per spec
Dishwasher, exposed Kitchen hood and exposed laundry room exhaust	Type 304 stainless steel, with #3 polished finish where exposed	Braze or weld airtight/watertight
Residential type clothes dryer exhaust	Snap lock galvanized steel minimum thickness 30 gauge per code	Mechanical band clamp connector (Ductmate Quick-Sleeve, or equal) No mechanical fasteners of any kind shall protrude into the airstream
Concealed kitchen hood exhaust	16 gauge black steel	Joints welded airtight/watertight, flanged and gasketed at connections to hood
Grease Ducts	Manufactured double wall	Installation to meet NFPA 96
Commercial laundry equipment exhaust	Type 304 stainless steel with #3 polished finish where exposed	Joints welded airtight/watertight, flanged and gasketed at connections. Inside surfaces smooth.

SERVICE	**MATERIAL**	**SPECIAL REQUIREMENTS**
Breachings and flues	10 gauge black steel	Joints welded airtight/watertight, flange at connections
Accessories, dampers and air turns	Same material and gauge as parent duct	----------

END OF SECTION

SECTION 233110 - GREASE DUCT SYSTEM

1.1 GREASE DUCT SYSTEMS

A. Provide factory built grease duct system laboratory tested and listed by the Underwriters Laboratories, Inc., for use with commercial cooking equipment as described in NFPA 96.

B. Double wall ducting shall have an outer jacket of aluminized steel .025 in. thick in 6 in. through 24 in. diameter and 0.34 in. thick for larger diameters. Exception! Where exposed to weather, the outer jacket shall be 0.25 in. stainless steel, type 304. There shall be a minimum 1 in. air space between the walls. The inner liner shall be Type 304 stainless steel with a nominal thickness of 0.35 in. for all sizes.

C. System shall be designed to provide access for inspection and cleaning at each change of duct direction; permit drainage of grease residue through a duct section; enable the system to allow for thermal expansion; and to allow for the specified fire suppression equipment to be integrated into the grease ductwork. Horizontal runs greater than 20 ft. per NFPA 96. Joints of the inner liner shall be sealed using V Bands and high temperature ceramic joint cement, as supplied by the manufacturer. Ducts extending above roof surfaces shall terminate as required by NFPA 96, and as called for.

D. Ductwork, accessories, equipment, and arrangement shall be provided with features and connectors to suit a Dry Chemical Extinguishing System per NFPA 17.

E. Provide ventilated roof thimbles, wall supports, wall guides, drain tees, access sections, adjustable lengths, plate support assemblies, duct drains, hood transitions, nozzle sections, and other factory make parts to suit the installations called for.

F. Provide a drawing showing application details for approval.

G. System shall be Selkirk Metalbestos Model PS Grease Duct.

1.2 INSTALLATION OF GREASE DUCT SYSTEMS

A. Install per NFPA 96 and according to special instruction for Model PS systems as follows:

1. Section A - General Information.

2. Section B - Tees, Elbows, Increasers.

3. Section C - Adjustable lengths, guiding and support.

4. Section D - Plate supports.

5. Section E - Wall supports and guides.

6. Section F - Roof and wall penetrations.

B. Provide Work above roof as follows:

1. Provide ventilated roof thimble storm collar and flashing. Flashing shall be of material and arrangement approved by Owner's Representative. Storm collar shall be stainless steel to match duct material.

2. Extend duct system beyond storm collar with 90° WYE with tee cap cleanout and then connect to utility blower.

3. Extend storm collar and duct to upblast type exhaust fan.

4. Provide packing and seal the entire system.

5. Duct Enclosure And Surroundings:

   a. All ductwork shall be housed in fire rated enclosures provided by General Contractor. Cooperate with the installing Contractor when locating ducts and supports so as to permit the installation of a proper fire resistant barrier.

6. Combustibles of any kind will not be permitted within 6 in. of any part of duct system.

END OF SECTION

SECTION 233313 - FIRE AND SMOKE DAMPERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services required for the complete installation as shown on the Contract Documents.

1.2 SUBMITTALS

A. Submit product data, types, schedule of sizes, locations, and installation arrangements of all dampers.

B. Submit manufacturer's UL listed installation details for each mounting arrangement.

1.3 QUALIFICATIONS

A. Provide work in accordance with the 2020 Mechanical Code of New York State UL 555, UL 555S and UL555C. Fire dampers shall be Underwriter's Laboratories classified and labeled. Smoke dampers and operator assemblies shall be Underwriter's Laboratories (UL) classified and labeled as an assembly.

PART 2 - PRODUCTS

2.1 CEILING RADIATION DAMPERS (Round Type)

A. The round ceiling radiation damper shall be a Warnock Hersey classified ceiling radiation damper. The damper shall be UL555 listed and labeled.

1. The damper frame shall be constructed of 20 gauge galvanized steel.

2. The blades of the damper shall be constructed of 20 gauge galvanized steel.

3. Fusible link temperature rating of 165°F.

4. Design Equipment: Ruskin Model CFDR2W or CFDR3W depending on the damper size.

5. Make: Ruskin or equivalent

2.2 CEILING RADIATION DAMPERS (Rectangular Type)

A. The rectangular ceiling radiation damper shall be a Warnock Hersey classified ceiling radiation damper. The damper shall be UL555 listed and labeled.

1. The damper frame shall be constructed of 20 gauge galvanized steel.

2. The blades of the damper shall be constructed of 22 gauge galvanized steel.

3. Fusible link temperature rating of 165°F.

4. Design Equipment: Ruskin Model CFD2W, CFD3W or CFD4W depending on the damper size.

5. Make: Ruskin or Equivalent.

2.3 FIRE DAMPERS (True Round Type)

A. True round damper of galvanized steel construction with fusible link, 20 gauge frame and 14 gauge blades. UL555 listed and labeled.

1. 100% free area with welded head.

2. Round duct connection as required by duct connections.

3. 1-1/2 hour rated dampers for walls or floors rated less than three hours.

4. With factory fabricated sleeve with and mounting plates.

5. Bearings to be stainless steel sleeve type, pressed into frame.

6. Fusible link temperature rating of 165°F.

B. Design Equipment: Ruskin Model FDR25 Round Fire Damper.

C. Make: Ruskin, Air Balance, National Controlled Air, Prefco, Venco, Greenheck, Nailor.

2.4 FIRE DAMPERS (Rectangular Type)

A. Curtain type damper of galvanized steel (304 stainless steel for ductwork containing shower room exhaust, wet location exhaust, and corrosive fume exhaust) construction with fusible link, 20 gauge frame and 24 gauge blades. UL listed and labeled.

1. 100% free area with welded head.

2. Square, rectangular, round or oval duct connection as required by duct connections.

3. 1-1/2 hour rated dampers for walls or floors rated less than three hours. Three-hour rated dampers for three and four hour walls or floors.

4. With factory fabricated sleeve with fixed and slip flanges.

5. Fusible link temperature rating of 165°F.

B. Design Equipment: Ruskin Model IBD2 Style B.

C. Make: Ruskin, Air Balance, National Controlled Air, Prefco, Venco, Greenheck, Nailor.

2.5 COMBINATION FIRE/SMOKE DAMPERS

A. Airfoil multiblade type damper of galvanized steel construction suitable for installation in high velocity duct systems up to 3000 fpm and 4 in. s.p. with 16 gauge hat channel frame

with corner reinforcement and blades equivalent to 14 gauge, silicone rubber blade edge seals, stainless steel bearings and flexible stainless steel jamb seals. UL listed and labeled.

1. UL listed 120 volt electric motor operator. Operator to be mounted outside of the air stream.

2. Square, rectangle, or round as required. Duct transitions for dampers in oval ducts.

3. With factory fabricated sleeve with fixed and slip flanges.

4. Class I leak rating of 4.0 cfm/ft^2 at 1 in. w.g. (8.0 cfm/ft^2 at 4 in. w.g.)

5. 1-1/2 hour fire rated. Fusible link temperature rating of 165°F.

B. Design Equipment: Ruskin FSD60.

C. Make: Ruskin, Air Balance, National Controlled Air, Greenheck, Nailor.

PART 3 - EXECUTION

3.1 LOCATIONS

A. Provide ceiling radiation dampers in all penetrations of the horizontal fire rated membrane.

B. Provide fire dampers in all one, two and three hour rated wall and floor penetrations.

C. Provide combination fire/smoke dampers as called for in penetrations of duct shafts as noted on the drawings.

3.2 INSTALLATION

A. Provide sleeve, angles, and access doors for installation in accordance with the latest requirements of SMACNA, NFPA, UL and damper manufacturer.

B. Provide sheet metal access doors with labels, as called for in Specification Section 233100 in ductwork for dampers and accessories.

C. Provide ceiling or wall access doors for dampers and accessories. Access door locations shall be coordinated with the project architect during construction.

D. Install dampers square and free from racking.

E. Do not compress or stretch the damper frame into the duct or opening.

F. Division 26 "Electric" will provide signal wiring and power wiring for smoke dampers. Smoke detectors shall be furnished by Division 26 "Electric and installed by division 23. Install detectors located in ductwork within 5'-0" of the damper. Increase duct size at smoke detectors, where required for proper installation, per smoke detector

manufacturer's recommendations. Coordinate minimum duct size and length for smoke detectors required with Division 26 "Electric".

3.3 CERTIFICATION

A. Contractor shall certify that dampers are accessible for servicing, are installed properly, and are operational. Submit three (3) copies of signed certification to the Owner's Representative for review.

3.4 IDENTIFICATION

A. Provide damper tags and charts.

1. Fasten tag to ductwork adjacent to the dampers.

2. Number each damper and make chart listing.

a. Number.

b. Location.

c. Air system in which they are installed.

B. Submit three (3) copies of chart to the Owner's Representative for review.

END OF SECTION

SECTION 233400 - FANS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services as required for the complete installation designed in Contract Drawings.

1.2 SUBMITTALS

A. Submit product data for all fans, motors, drives, and accessories. Include all fan curves fan operating point, and sound data.

1.3 QUALITY ASSURANCE

A. Capacity, size and arrangement, static pressure, brake horsepower, component parts and accessories shall be provided as called for or scheduled. Guaranteed full capacity delivery through duct systems finally installed and under conditions listed. The manufacturer shall guarantee sound-power level ratings not exceeding those of the design equipment. All equipment shall be statically and dynamically balanced to acceptable tolerances with weights permanently fastened. Fan wheels shall be rebalanced in the field, if necessary.

B. Pressure Classification:

Maximum Total Sp	Class
Up to 3-3/4 in. WG-STD	I
Up to 6-3/4 in. WG-STD	II
Up to 12-3/4 in. WG-STD	III

C. Conventional Motors:

1. Motor sizes shall be as scheduled. Refer to Specification Section 230513 for motor types, efficiency requirements, and acceptable motor manufacturers. All belt-driven fan motors shall be mounted on either an adjustable slide base or a pivoting base.

D. EC Motors:

1. Motors shall be Electronically Commutated Type (EC), variable speed, DC, brushless motors specifically designed for use with single phase, 277 volt (or 120 volt), 60 hertz electrical input.

2. Motor shall be complete with and operated by a single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator.

3. Motors shall be designed for synchronous rotation. Motor rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in-soft start and soft speed change ramps.

4. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motors shall be direct coupled to the blower.

5. Motor shall maintain a minimum of 85% efficiency over its entire operating range and have a turndown to 20% of full speed, (80% turndown).

6. Provide manual fan speed output control for field adjustment of the fan airflow setpoint.

7. Inductors shall be provided to minimize harmonic distortion and line noise.

8. Provide isolation between fan motor assembly and unit casing to eliminate any vibration from the fan to the terminal unit casing.

9. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.

10. The fan manufacturer shall provide a factory installed PWM controller for either manual or DDC controlled fan CFM adjustment. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM controller shall be capable of receiving a 0-10 VDC signal from the DDC controller (provided by the controls contractor) to control the fan CFM. When the manual PWM controller is used, the factory shall present the fan CFMs as shown on the schedule.

11. Acceptable Manufacturers: Emerson Ultratech, U.S. Motors-Nidec, GE-ECM, A.O. Smith or equivalent.

E. Drive Systems:

1. Provide fans with belt or direct drive systems as scheduled. V-belt drives as recommended by drive manufacturer, unless otherwise specified or scheduled.

   a. Size drive for 200% of motor rating when motor is 10 HP and larger. Size for 150% of motor rating when motor is less than 10 HP.

   b. Motors 5 HP and larger shall be provided with a minimum of two (2) belts. All belt sets shall be matched.

   c. Cast iron or cast steel pulleys.

   d. Provide belt and shaft guards for each driven device. Provide openings in both the motor and fan sections of the guard so that the motor and fan speeds can be checked without removing the belt guard.

   e. Belts shall be oil and heat resistant, non-static type.

f. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts.

g. All belt drive fan motor selections must include an allowance for medium drive losses as established by AMCA Publication 203.

F. Motor Pulleys:

1. 5 HP and Smaller: Adjustable type to produce 15% speed change above and below scheduled fan speed. 7-1/2 HP and Larger: Fixed type.

2. 5 HP and Smaller: "A" section, 2.6 in. minimum pitch diameter.

3. 7-1/2 HP to 20 HP: "B" section, 4.6 in. minimum pitch diameter.

4. 25 HP and Larger: "C" section 7.0 in. minimum pitch diameter.

5. Drive ratio not over 4:1.

G. Bearings:

1. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy-duty regreasable ball type in a pillow block cast iron housing selected for a minimum L50 life in excess of 200,000 hours as maximum cataloged operating speed.

H. Wheels and Propellers:

1. All wheels and propellers shall be balanced in accordance with AMCA Standard 204-96, balance quality and vibration levels for fans. Wheel shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.

2. Blades on all sizes shall be continuously welded to the backplate and deep spun inlet shroud.

3. All hubs shall be keyed and securely attached to the fan shaft.

I. Blower Shafts:

1. All blower shafts shall be AISI-C-1045 hot rolled and accurately turned, ground and polished. Shafting shall be sized for a critical speed of at least 125% of maximum cataloged operating speed.

J. Coating:

1. All steel fan components shall contain an electrostatically applied, baked polyester powder coating. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

K. Vibration isolation for units shall be furnished by the fan manufacturer unless otherwise noted. Provide guided springtype vibration isolators.

L. Certifications:

1. Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (CUL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.

2. All units shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit-tested packaging.

PART 2 - PRODUCTS

A. Square Centrifugal:

1. Construction:

a. The fan shall be bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel with integral inlet and outlet flanges.

b. Pivoting motor plate shall utilize threaded L-studs for positive belt tensioning.

c. Bolted access doors shall be provided on three (3) sides, sealed with close cell neoprene gasketing.

d. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation.

2. Wheel:

a. Wheel shall be aluminum, non-overloading, centrifugal backward inclined, flat blade type. Hub shall be cast and precision machined, also constructed of 100% aluminum.

3. Accessories:

a. Motor Cover.

b. Inlet/Outlet Flex Duct connector.

c. Disconnect Switch - Factory wired and mounted.

d. Backdraft Damper

e. Speed Controller (For Direct Drive Models Only) - Factory wired and mounted

4. Basis-of-DesignProduct indicated in schedule.

B. Ceiling, Wall or Inline Mounted, Direct Driven, Centrifugal Exhaust Fan:

1. Construction:

a. The fan housing shall be minimum 20 gauge galvanized steel and acoustically insulated.

b. Blower and motor assembly shall be mounted to a minimum 14 gauge reinforcing channel. Motor shall be resiliently mounted.

c. Unit shall be supplied with integral wiring box.

d. Discharge position shall be convertible from right angle to straight through by moving interchangeable panels. The outlet duct collar shall include reinforced aluminum dampers with continuous aluminum hinge rods and brass bushings. To accommodate different ceiling thickness, an adjustable prepunched mounting bracket shall be provided.

e. A powder painted white steel grille shall be provided as standard.

2. Wheel:

a. Wheels shall be twin DWDI centrifugal forward curved type, constructed of galvanized steel.

3. Accessories:

a. Disconnect switch - Factory mounted and wired.

b. Fan Speed Controller (For Direct Drive Models Only) - Factory mounted and wired.

4. Basis-of-Design: Product indicated in schedule.

2.2 ROOF FANS

A. Manufacturers: Subject to compliance with requirements of this section, provide products by one of the following:

1. Acme, Cook, Greenheck, Twin City, PennBarry.

B. Spun Aluminum Downblast Centrifugal Exhaust Ventilator:

1. Construction:

a. The fan shall be bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure.

b. The aluminum base shall have continuously welded curb cap corners for maximum leak protection, and shall be tall enough to cover the wood nailer on roof curb.

c. The discharge baffle shall have a rolled bead for added strength.

d. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections.

e. Bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream.

f. Hinged at curb so that entire fan can be tilted upward for maintenance, access to dampers, and access to damper motor.

g. 1/2 in. x 1/2 in. aluminum wire mesh bird screen.

2. Wheel:

a. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub.

3. Accessories:

a. Backdraft Damper - Gravity.

b. Backdraft Damper - Motorized.

c. Roof Curb - In accordance with Section 230530.

d. Disconnect Switch - Factory wired and mounted.

e. Fan Speed Controller (For Direct Drive Models Only) - Factory wired and mounted.

4. Basis-of-Design: Product indicated in schedule.

C. Spun Aluminum Upblast Centrifugal Kitchen Exhaust Ventilator:

1. Construction:

a. The fan shall be bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure.

b. The aluminum base shall have continuously welded curb cap corners for maximum leak protection.

c. The discharge baffle shall have a rolled bead for added strength.

d. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections.

e. Bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A 1 in. thick, three pound density foil back heat shield shall be utilized to protect the motor.

f. Hinged at curb so that entire fan can be tilted upward to permit inspection and cleaning, as required for commercial cooking equipment by NFPA 96. Provide service hold-open cables.

2. Wheel:

a. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub.

3. Certifications:

a. For grease laden vapor applications, fan shall be listed by Underwriters Laboratories (UL 762) and UL listed for Canada (Power ventilator for restaurant exhaust applications).

4. Accessories:

a. Hinged Base.

b. Disconnect Switch.

c. Vented Curb Extension.

d. Roof Curb Specifically Designed for Grease Applications.

e. Grease Collection System.

f. Grease Trough.

5. Basis-of-Design: Product indicated in schedule.

2.3 CONTROL (MOTORIZED) DAMPERS

A. Manufacturers: Subject to compliance with requirements of this section, provide products by one of the following:

1. Ruskin, Tamco, Greenheck.

B. Provide control dampers as shown on the drawings and diagrams, to meet the following minimum construction standards:

1. Leakage: Class 1, 4 CFM/sq. ft. at 1 in. w.c., tested per AMCA Standard 500-D-98, and AMCA Standard 500-D-98, and AMCA Standard 511 and bearing AMCA's Certified Ratings for both air performance and air leakage.

2. Frame: 16 gauge galvanized steel structural hat channel with tabbed corners for reinforcement to meet 13 gauge criteria.

3. Blades: 14 gauge (equivalent thickness galvanized steel) roll forward air foil type for low pressure drop and low noise generation. Blades shall be parallel for two-position dampers and opposed, for modulating dampers.

4. Blade Seals: Ruskiprene, suitable for -72°F to 275°F mechanically locked into the blade edge.

5. Jamb Seals: Flexible metal compression type.

6. Blade Axles: 1/2 in. plated steel hexagonal positively locked into the damper blade. Linkage concealed out of the airstream.

7. Bearings: Corrosion resistant, permanently lubricated stainless steel sleeve.

8. Dampers subject to corrosive fumes or humidity shall be constructed of stainless steel.

9. Dampers over 48 in. in length and height shall be made in multiple sections.

10. Where damper sizes are not specifically indicated, they shall be sized by the Building Management System Contractor Maximum velocity shall be 1500 FPM and maximum pressure drop 0.1 in. w.g.

11. Where shown or required for proof of closure or open position, provide factory installed damper positioning switch package Ruskin Model SP-100.

12. Dampers shall be as manufactured by Ruskin CD 60 control damper, or equivalent Tamco, Greenheck or Nailor.

13. Basis of Design: Ruskin CD60

2.4 BACKDRAFT DAMPERS (HORIZONTAL MOUNT - AIR FLOW UP) (1000 FPM AND 1500 FPM)

A. Manufacturers: Subject to compliance with requirements of this section, provide products by one of the following:

1. Ruskin, Greenheck, Air Balance Inc., American Warming and Ventilating, Nailor.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1000 FPM (Ruskin BD2/A1Maximum System Pressure: 1.5 in. w.g.

D. Operating Pressure: BD2A1 .03 in. w.g. start to open - .10 blades fully open.

E. Frame: Hat-shaped 6063TS .090 in. thick extruded aluminum with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, maximum 6 in. width, 0.025 in. thick, roll-formed aluminum (BD2A1 with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel.

2. Diameter: 0.20 in.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.

2. Counterweights and spring-assist kits for vertical airflow installations.

N. Basis of Design: Ruskin BD2A1

2.5 BACKDRAFT AND PRESSURE RELIEF DAMPERS (HORIZONTAL MOUNT - AIR FLOW UP) (1500 - 2500 FPM)

A. Manufacturers: Subject to compliance with requirements of this section, provide products by one of the following:

1. Ruskin, Greenheck, Air Balance Inc., American Warming and Ventilating, Nailor.

B. Description: Gravity balanced

C. Maximum Air Velocity: 1500 to 2500 FPM.

D. Maximum System Pressure: 4 in. w.g.

E. Operating Pressure: .12 in. w.g. blades start to open, .20 in. w.g. blades fully open.

F. Frame: Hat-shaped, 6063TS - .070 in. thick extruded aluminum, with welded corners or mechanically attached and mounting flange.

G. Blades: Multiple single-piece blades, end pivoted, maximum 6 in. width, .070 in. thick, roll-formed aluminum with sealed edges.

H. Blade Action: Parallel.

I. Blade Seals: Extruded vinyl, mechanically locked.

J. Blade Axles:

1. Material: Galvanized steel.

2. Diameter: 0.20 in.

K. Tie Bars and Brackets: Aluminum.

L. Return Spring: Adjustable tension.

M. Bearings: Synthetic pivot bushings.

N. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.

2. Counterweights and spring-assist kits for vertical airflow installations.

3. SPC static pressure control.

O. Basis of Design: Ruskin BDG (gravity balanced)

PART 3 - EXECUTION

3.1 INSTALLATION OF EQUIPMENT

A. Provide equipment in accordance with manufacturer's instructions. All fans shall meet the intent of the system performance requirements. Provide rubber in-shear vibration isolation for all fans unless otherwise called for. Provide necessary support steel for equipment. Provide guards for all exposed belts, shafts, and fan wheels. Change pulley sizes or adjust sheaves as required to make systems deliver specified quantities of air as listed on the Contract Drawings.

END OF SECTION

SECTION 233713 - REGISTERS AND DIFFUSERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services required for the complete installation designed in Contract Documents.

1.2 SUBMITTALS

A. Registers/Grilles/Diffusers: Submit product data including room schedule listing size, CFM, throw, direction of throw, accessories, finish, material type, color chart, pressure drop and noise criteria.

1.3 GENERAL REQUIREMENTS

A. Each manufacturer shall check noise level ratings for registers and diffusers to insure that the sizes selected will not produce noise to exceed N.C. - 24, measured at occupant level; notify Owner's Representative of problems prior to submittal.

B. Pressure drop, airflow and noise criteria selection is based on design equipment. Manufacturers not submitting design makes must provide written certification in front of submittal that equipment submitted has been checked against and performs equal to the design make.

C. Borders and frames shall be coordinated with materials and ceiling systems to integrate with architectural ceiling details and finishes scheduled.

D. Locations of ceiling mounted air terminal devices shall be coordinated with locations shown on architectural reflected ceiling plans.

E. 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. 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.

1.4 REQUIREMENTS FOR REGISTERS

A. General:

1. A register is defined as a grille plus a volume damper.

2. Registers shall be installed "sight-proof" where possible, i.e.: High wall register with horizontal blades inclined up, or along a wall with blades facing the wall.

3. Borders and frames shall be of the same material as register face unless specified otherwise.

B. Mounting Frames:

1. Provide with screw holes in register face punched and countersunk at factory, and mounting frame drilled and tapped to suit. Sponge rubber gasket between frame and wall or ceiling for all surface mounted frames.

2. Frame shall be overlap type and shall be suitable for type of ceiling where register is to be installed.

C. Finishes:

1. Baked enamel (of colors as selected from the manufacturer's standard color chart) as scheduled.

D. Design Equipment: Titus unless otherwise noted.

E. Manufacturers: Anemostat, Carnes, Krueger, Titus, Price, Tuttle and Bailey, Nailor.

1.5 REQUIREMENTS FOR DIFFUSERS

A. General:

1. Provide four way blow unless otherwise noted.

2. Where manufacturer's size recommendations require duct sizes or connections differing from design, Contractor shall provide at no change in contract price.

3. Suitable for recessed mounting unless otherwise indicated.

4. Provide square to round neck transitions as required.

5. Provide sponge rubber gasket for all surface mounted frames.

B. Finishes:

1. Baked enamel (of colors as selected from the manufacturer's standard color chart) as scheduled.

C. Frame style shall be suitable for ceiling type in which diffuser is to be installed.

D. Design Equipment: Titus unless otherwise noted.

E. Manufacturers: Anemostat, Carnes, Krueger, Titus, Price, Tuttle and Bailey, Nailor.

PART 2 - PRODUCTS

2.1 SUPPLY TYPES

A. Type 1 - (Smooth Face Type):

1. Steel construction with 22 gauge back pan and 22 gauge face panel with rolled edges that finishes flush with ceiling system.

2. Round neck - minimum 1-1/4 in. collar for duct connection.

3. Frame suitable for ceiling type.

4. With optional directional air flow pattern controllers that are concealed behind the face or in the neck.

5. Face panel shall be removed and securely held in place to the back pan without noise or vibration.

6. Horizontal airflow pattern.

7. Panel Size: 24 in. x 24 in.

8. Model: Titus OMNI.

B. Type 2 - (Supply Air Grille):

1. Steel 20 gauge frame construction with double deflection capability and the front blades shall be parallel to the long dimension. Solid extruded aluminum air foil blades mounted in friction pivots for individual blade adjustment, spaced on 3/4 in. centers.

2. 1-1/4 in. wide flange with sponge rubber gasket.

3. Model: Titus 272-RL.

2.2 RETURN/EXHAUST TYPES

A. Type A - (Aluminum Exhaust and Return Grille):

1. Aluminum construction with horizontal blades on a 3/4 in. spacing and set at 35° fixed deflection.

2. 1-1/4 in. wide border with minimum thickness of .040 - .050 in. interlocked at all four corners and mechanically fastened.

3. The blades shall be parallel to long dimension.

4. Model: Titus 350-FL

B. Type B - (Exhaust and Return Grilles):

1. Steel construction with 22 gauge frame and blades, with horizontal bars on a 3/4 in. spacing set at 35° fixed deflection.

2. 1-1/4 in. wide flange.

3. The blades shall be parallel to long dimension.

4. Model: Titus 350-RL

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in strict accordance with manufacturer's instructions. Rough in or install per reflected ceiling plan or in location instructed by Owner's Representative.

B. Provide approved air extractors behind all duct mounted supply registers in exposed ductwork.

C. When the final connection to an exhaust or return grille is made, a 12 in. minimum height plenum box must be supplied to all grilles. Plenum dimensions shall match grille size. Paint inside of plenum box flat black. Provide 1 in. acoustical lining in plenum box. Oversize the plenum to account for the thickness of the lining.

D. Seal all supply and return registers, grilles and diffusers during construction operations to limit dust entering HVAC systems and ductwork. Seals may be removed just prior to testing and balancing, but not without the approval of the Owner's Representative.

END OF SECTION

SECTION 233723.16 - LOUVERS AND PENTHOUSES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services required for the complete installation designed in Contract Documents.

1.2 SUBMITTALS TO THE ARCHITECT/ENGINEER

A. Louvers including all blade types, finishes, and arrangements.

B. Penthouses including materials, finishes and accessories.

C. Provide original color charts for selection of finish.

PART 2 - PRODUCTS

2.1 LOUVERS

A. Factory constructed high performance drainable, fixed, extruded aluminum 6 in. deep louvers.

B. Provide mullions where blade lengths exceed 60 in.

C. Sill extension and sill style as required by job conditions.

D. Heads, sills and jambs to be one piece structural members of 6063-T6 alloy with integral caulking slot and retaining beads.

E. Mullions shall be sliding interlock with internal drain(s).

F. Blades to be one piece extrusions with gutter(s) designed to catch and direct water to jamb and mullion drains.

G. Extrusion thicknesses shall be as follows: Heads, Sills, jambs and mullions: 0.115". Fixed Blades: 0.125"

H. Closed cell PVC compression gaskets shall be provided between bottom of the mullion or jamb and the top of the sill to insure leak tight connections.

I. All fasteners to be aluminum or stainless steel.

J. All louvers to be furnished with 5/8 in. flattened expanded mesh, aluminum bird screen with a .055 in. thick extruded aluminum frame. Screens and screen frames to be standard mill finish.

K. All louvers shall be finished with powder coating of a color to be selected at the time of submittal review. Coating to be 1.5 to 3 mil. thick full strength 100% resin Fluoropolymer coating. Finish to adhere to a 4H Hardness rating. The louver

manufacturer shall supply an industry standard 20-year limited warranty against failure or excessive fading of the Fluoropolymer powder coat finish.

L. Design Equipment: As Scheduled

M. Makes: Construction Specialties, Inc., American Warming & Ventilating Inc., Arrow United Industries, Louvers & Dampers, Inc., Ruskin, Nailor.

PART 3 - EXECUTION

3.1 GENERAL

A. Install louvers and penthouses as per manufacturer's recommendations.

3.2 LOUVERS

A. Size called for is approximate wall/or masonry opening size. Adjust slightly to suit construction or coursing (review architectural drawings or field conditions for rough opening sizes.) Slope ductwork, and plenum to louver weephole or provide drain.

B. Structural supports shall be designed and furnished by the louver manufacturer to carry a wind load in accordance with the Building Code of New York State.

END OF SECTION

SECTION 235102 - PREFABRICATED FLUE GAS VENTING SYSTEM (AL29-4C)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. All work in this section shall comply with the General Mechanical Specifications.

B. This section includes specifications for furnishing and installing Non-Positive and Positive Pressure Vent systems for Condensing and Non-Condensing applications.

1.2 QUALITY ASSURANCE

A. Where applicable, products furnished under this section shall conform to the requirements of NFPA 54 and NFPA 211, and shall comply with UL 1738, Standard for Venting Systems for Category I, II, III, and IV Gas-Burning Appliances, and all other applicable standards.

B. All flue gas carrying components of the vent system shall be obtained from a single manufacturer.

C. The flue gas venting system materials must be furnished by the manufacturer of the boiler or water heater if the efficiency is greater than 85%, as per the requirements of NFPA 85 and 211.

D. The flue gas venting system shall have a warranty of ten (10) years (minimum).

1.3 SUBMITTALS

A. Submit a fully dimensioned, scaled shop drawing, showing plan and elevational views of the entire flue gas venting system. The detailed drawing shall indicate all section sizes and the specific fittings to be installed. The drawing shall include all supports (vertical and horizontal) applicable to the project. The drawing shall be prepared and approved by the system manufacturer.

B. Submit product data showing complete material and construction details for flue gas venting system and accessories.

C. Submit Drawings showing floor and roof openings, which shall indicate exact sizes and locations.

D. Provide documentation of a product warranty of ten (10) years or more.

PART 2 - PRODUCTS

2.1 SPECIAL GAS VENT

A. Vent shall have a 1 in. space, and have an inner liner constructed of AL29-4C superferritic stainless steel with a minimum thickness that shall meet or exceed the requirements of UL 1738. All products shall be factory-built special gas type, engineered and designed for use on Category I, II, III, and IV appliances.

B. Maximum positive pressure rating of 6 in. wc.

C. Maximum continuous flue gas temperature shall not exceed 550°F (288°C).

D. Vent shall be constructed with an inner conduit constructed of AL29-4C superferritic stainless steel with a minimum thickness that shall meet or exceed the requirements of UL 1738. The closure system shall be a Ring-and-Tab mechanical closure system that is integral to the system.

E. The outer wall casing shall be constructed of 430 stainless steel that shall not require additional surface preparation, such as painting, in order to withstand the outdoors or high humidity environments.

F. Inner conduit and outer wall casing shall be constructed in a fashion which prevents cross-alloy contamination and allows free movement between the two, allowing for varying rates of expansion and contraction to occur.

G. System is to be sized in accordance with the appliance manufacturer's specifications, NFPA 54-National Fuel Gas Code (ANSI Z223.1), ASHRAE recommendations, and other applicable codes.

H. Contractor shall supply double wall AL29-4C product for all exhaust gas carrying runs. Combustion air intake shall be single wall galvanized duct with insulation as specified in Specification Section 230710.

I. Joints to be sealed with factory supplied sealant. Joints shall be designed to minimize collection of condensate in both horizontal and vertical runs. Joints shall not use screws or other lesser alloy fasteners that penetrate the inner conduit.

J. General Electric RTV106 High Temperature Silicone Sealant shall be used to seal all joints on systems where the maximum flue gas temperature will not exceed 550°F.

K. Dow Corning 732 RTV Sealant may be used to seal all joints on systems where the maximum flue gas temperature will not exceed 300°F.

L. Design Equipment: Heat Fab.

M. Acceptable Manufacturers: Heat-Fab, Hart and Cooley, Ampco, Schebler.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Provide flue gas venting systems of sizes as shown on Drawings. Sizes are clear inside dimensions. Maintain minimum clearances between vent system and existing construction.

B. Install in strict accordance with NFPA 54, NFPA 211 and manufacturers recommendations.

C. Provide adjustable lengths between two fixed points to permit thermal expansion.

D. Seal joints with sealant suitable for temperature in excess of specified intermittent flue temperature ratings.

E. Support as recommended by the manufacturer. Provide all necessary braces, guides, guy wires, tensioners and supports. Fasteners shall penetrate wall and terminate on inside of wall with steel bearing plates.

F. Provide threaded hose end ball valve with cap and chain, at base of drained tee fitting.

G. Individual flues that penetrate the roof shall terminate a minimum of 4 ft. apart, or as per the manufacturer's recommendations.

H. Horizontal runs of a flue gas venting system shall be installed at a slope of not less than 1/4 in. per foot, to allow for proper drainage of condensate back to the boiler or water heater condensate disposal system.

END OF SECTION

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged, factory fabricated and assembled, gas fired, condensing boilers, trim, and accessories for generating hot water

1.2 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Shall be submitted to the Engineer for approval and shall consist of:

1. General assembly drawing of the boiler including product description, model number, dimensions, clearances, weights, service sizes, etc.

2. Schematic flow diagram of gas valve trains.

3. Schematic wiring diagram of boiler control system. Schematic wiring diagram shall be ladder type showing all components, interlocks, etc. Schematic wiring diagram shall clearly identify factory wiring and field wiring.

C. Installation Instructions: Manufacturer's printed instructions for installation shall be submitted to the Engineer for approval.

D. Boiler Inspector's Certifications: As specified hereinafter, shall be submitted in writing prior to final acceptance by the Engineer.

E. Factory Test Reports: Factory test reports, as specified hereinafter, shall be submitted prior to final acceptance by the Engineer.

F. Field Test Reports: Field test reports, as specified hereinafter, shall be submitted prior to final acceptance by the Engineer.

G. Operation and Maintenance Manuals: Manufacturer's printed operation and maintenance manuals shall be submitted prior to final acceptance by the Engineer. Operation and maintenance manuals shall contain shop drawings, product data, operating instructions, cleaning procedures, replacement parts list, maintenance and repair data, complete parts list, etc.

H. Manufacturer's Field Service: Manufacturer's printed field service procedures shall be submitted prior to final acceptance by the Engineer. Field service procedures shall include the name of boiler manufacturer's field service manager and phone number of boiler manufacturer's field service department.

1.3 SEISMIC SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Section 230529 "Seismic Restraint for Mechanical Systems". Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified" and the unit will be fully operational after the seismic event.

b. The specified field tests have been satisfactorily performed.

c. Seismic Anchorage:

1) Certified seismic anchorage calculations prepared by a registered professional Structural Engineer for seismic zone (1, 2A, 2B, 3 or 4). Include horizontal and vertical working load and bolting force calculations. Include anchor specification and locations.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 WARRANTIES

A. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of eighteen (18) months from date of shipment, or twelve (12) months from date of start-up, whichever occurs first. Heat exchanger and fuel burner shall be warranted for a period of five (5) years from date of shipment.

B. Warranty Period for Water Tube Boiler: Twelve (12) years from date of Substantial Completion.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.6 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. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements".

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers".

E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment". Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

F. Shall be in accordance with NFPA 91, NFPA 211, and NFPA54.

G. Boilers/burners shall be provided in accordance with applicable requirements of New York State Labor Department Industrial Code Rule No. 4 (cited as 12 NYCRR4) and Code Rule No. 14 (cited as 12 NYCRR14)

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis of Design Product: Subject to compliance with these requirements, provide Laars Heating Systems or comparable product as manufactured by:

1. Lochihvar Corporation

2. Viessmann Manufacturing Co. (US) Inc.

3. Laars Heating Systems.

2.2 MANUFACTURED UNITS

A. The boiler shall modulate 20-100% of full fire. The unit(s) shall be design-certified to comply with the current edition of the Harmonized ANSI Z21.13 / CSA 4.9 Standard for Gas-Fired Low Pressure Steam and Hot Water Boilers. The unit(s) shall be designed and constructed in accordance with the ASME Boiler & Pressure Vessel Code, Section IV requirements for 160 psi (1103 kPa) maximum working pressure, and shall bear ASME "H" Stamp and be listed by the National Board. The unit(s) shall be constructed to comply with the efficiency requirements of the latest edition of ASHRAE Standard 90.1.

B. The boiler shall be equipped with an ASME certified pressure relief valve set at 75 psi (517 kPa).

C. The boiler shall be listed with AHRI (Air Conditioning, Heating and Refrigeration Institute).

D. The boiler shall have a minimum thermal efficiency of 94%, and a minimum combustion efficiency of 95%.

E. The water tube heat exchanger shall be stainless steel, rated for 160 psi (1103kPa) working pressure. The heat exchanger shall be a low water volume design, welded construction, with no gaskets, o-rings, or bolts in the header. Heat exchanger shall be accessible for visual inspection and cleaning of all internal surfaces.

F. The boiler shall be fully condensing design with built-in condensate drain and trap.

G. Each boiler shall be fully test fired, (with water, gas, and venting connected), and all safety components tested, at the factory.

H. The boiler shall be sealed combustion, and removal of jacket panels shall not affect the combustion seal. The boiler jacket shall be a unitized shell finished with acrylic thermos-set paint backed at no less than 325°F (163°C). The frame shall be constructed of galvanized steel for strength and protection. Chamber shall include a sight glass for viewing flame. Boiler shall be certified for zero clearance to combustible surfaces.

I. All water, gas, vent and air connections shall be on the top of the boiler, and the top jacket panels shall be split, such that they are removable without disconnecting the water, gas, vent or air pipes.

J. The boiler shall be shipped with a pump and a conduit. The wiring and terminals shall be wired to the pump. The boiler shall have a flanged inlet water connection that allows the pump to be connected directly to the top of the boiler in the field. The pump shall be capable of serving the boiler's heat exchanger and 30 feet of piping that is the same size as the boiler's water connections, with a normal number of pipe fittings.

K. Boiler shall operate on 4-13" w.c. gas pressure, and shall need no component changes to operate at high altitude, up to 10,000 feet.

L. The boiler shall use a premix burner with a stainless steel woven metal fiber wrap, and a negative pressure gas valve to burn cleanly, with NOx emissions not exceeding 10 ppm. The boiler shall meet the emissions requirements of SCAQMD 2012.

M. The boiler shall be designed for vertical or horizontal Category V venting, up to 100 equivalent feet with 4 inch diameter PVC, CPVC or stainless steel vent material. Air may be taken from the room, or ducted directly to the boiler, using up to 100 equivalent feet with 4 inch diameter ABS, PVC, CPVC or galvanized pipe,

N. Unit shall be 120 VAC, single-phase, less than 6 AMPS (including mounted pumps) for connection to a 15 AMP breaker. The control circuit shall be 24 VAC.

O. The boiler shall be an integrated electronic PID temperature and ignition control with LCD and touchpad and shall control the boiler operation and firing rate. The boiler display shall be visible without the removal of any jacket panels or control panels. The control shall have the ability to control the boiler pump, system pump and indirect domestic water pump, each with delay features. The control shall be able to cascade and lead-lag with other NeoTherm controller, without additional system controllers.

P. The control shall have built-in outdoor reset feature with customizable reset curves, based on the outdoor temperature and desired system water temperature. The boiler shall be shipped with the outdoor reset sensor, as standard equipment.

Q. The control shall have the ability to accept a 4-20 mA or 0-10 VCD input connection from an external control or building automation system, to modulate the flame. The control shall have dry alarm contacts for ignition failure. The control shall monitor flue gas temperature and shall stop the boiler from firing if temperature is excessive.

R. The control shall easily allow the user to force the boiler into minimum or maximum firing rate, for boiler setup and diagnostic purposes. Control shall have three (3) menu structures for user mode, setup mode and diagnostic mode.

S. The control shall have a variable pump control option.

T. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

U. Boiler shall have dual low water cutoff control.

2.3 TRIM

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping".

B. Two primary low water flow fuel cutoffs (prove type with manual reset).

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2 inch diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Automatic.

F. Manual reset high limit water temperature controller.

G. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

2.4 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.

2. Wiring shall be numbered and color-coded to match wiring diagram.

3. Install factory wiring outside of an enclosure in a metal raceway.

4. Field power interface shall be fused disconnect switch.

5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.

6. Provide each motor with overcurrent protection.

2.5 VENTING KITS

A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.6 SOURCE QUALITY CONTROL

A. Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME "H" stamp.

B. Each factory "packaged" boiler shall be fire tested. The boiler manufacturer shall perform this fire test under simulated operating conditions, with the boiler attached to a working chimney system and with water circulating through the boiler. The manufacturer shall provide a fire test report, including fuel and air settings and combustion test results permanently affixed to the boiler.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for the timely delivery of the equipment to the jobsite. The Contractor shall be responsible for unloading and rigging of the equipment. The Contractor shall be responsible for protecting the equipment from the weather, humidity and temperature conditions, dirt, dust, other contaminants, as well as jobsite conditions during construction.

B. Equipment shall be unloaded, handled, and stored in accordance with the manufacturer's handling and storage instructions.

3.2 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. The installation shall be provided by the Contractor in accordance with the requirements of the codes specified hereinbefore. All of the Contractor's work shall be performed in a workmanlike manner, by experienced workmen previously engaged in boiler plant construction and shall be under the supervision of a qualified installation supervisor.

B. Install equipment in strict compliance with manufacturer's installation instructions.

C. Install equipment in strict compliance with state and local codes and applicable NFPA standards.

D. Maintain manufacturer's recommended clearances around sides and over top of equipment.

E. Install components that were removed from equipment for shipping purposes.

F. Install components that were furnished loose with equipment for field installation.

G. Provide all electrical control and power interconnect wiring.

H. Provide all fuel gas vent and service piping.

I. Provide all piping for boiler pipe connections.

J. Contractor must, when filling the system with treated water, verify that the pH level is maintained between 6.0 and 8.5.

K. Contractor must verify that glycol and other additives must be approved by the glycol manufacturer for use in aluminum boilers and verify that the pH level is maintained between 6.0 and 8.5.

3.4 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 components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.

2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature

b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within twelve (12) months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two (2) visits to Project during other than normal occupancy hours for this purpose.

E. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.

2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.

3. Perform field performance tests to determine capacity and efficiency of boilers.

a. Test for full capacity.

b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.

5. Provide analysis equipment required to determine performance.

6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.

7. Notify Architect in advance of test dates.

8. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Video training sessions. Refer to Section 017900, "Demonstration and Training".

END OF SECTION

SECTION 236426.20 - AIR-COOLED ROTARY SCREW WATER CHILLER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide all materials, equipment and services as described in the Contract Documents.

1.2 SUBMITTALS

A. ARI certified part load performance data for 100%, 75%, 50% and 25% load.

B. Dimensional data and weights of all sections.

C. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, sound data, weights (shipping, installed, and operating), furnished specialties and accessories; and installation and start-up instructions.

D. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

E. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply to units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed and wiring by others.

F. Clearly identify all equipment and accessories included in quotation, as well as any Scope of Work excluded. List and identify any Scope of Work required of other companies.

1.3 START-UP AND INSTALLATION DATA

A. Manufacturer of refrigeration machine responsible for:

1. Furnishing complete installation drawings, templates, wiring diagrams, refrigerant piping diagrams, and instruction manuals for the equipment.

2. Submitting drawings either made especially for this job or distinctly modified for same; errors resulting from use of standard factory drawings, responsibility of this Manufacturer.

3. Supervising and checking installation for compliance with manufacturer's recommendations.

4. Checking out machines and actual start-up of same.

5. Advising and assisting Contractor in making final adjustments, i.e.:

a. Regulating flow of chilled water, sizing of refrigerant piping, etc.

b. To provide for proper balance and most economical operation, such as setting operating controls and setting and checking safety.

6. Providing five (5) year parts and labor warranty. This coverage will not exceed five (5) years from start up or five (5) years and six (6) months from shipment, whichever occurs first.

7. Furnishing Engineers log of results, all balancing and adjusting for various load conditions, including pressures, temperatures, flow quantities, etc.

8. Furnishing Contractor and Engineer with exact location and arrangement of all piping thermostats, flow switches, gauges, thermometers, insertion wells, etc., required.

9. Thoroughly instructing Owner's operating, personnel in proper operation of equipment.

1.4 GENERAL REQUIREMENTS

A. Completely factory assembled, wired and tested prior to shipment. Include initial charge of lubricating oil.

B. Chillers shall shut down for low oil pressure, condenser high pressure, chilled water low temperature, motor overload.

C. Chiller performance shall be in ARI certified in accordance with Standard 550-88 for the conditions scheduled.

D. Chiller shall comply with the requirements of ASHRAE Standard 15 - Safety Code for Mechanical Refrigeration.

1.5 QUALITY ASSURANCE

A. Qualifications: Equipment manufacturer must specialize in the manufacture of the products specified and have five years experience with the type of equipment and refrigerant offered.

B. Regulatory Requirements: Comply with the codes and standards specified.

C. Chiller manufacturer plant must be ISO Registered.

1.6 DEIVERY AND HANDLING

A. The outdoor unit shall be delivered to the job site with condensing section completely assembled and a holding charge of nitrogen.

B. Comply with the manufacturer's instructions for rigging and handling equipment.

1.7 WARRANTY

A. Standard Warranty (Domestic): The refrigeration equipment manufacturer's guarantee shall be for a period of one year from date of equipment start-up but not more than 18 months from shipment. The guarantee shall provide for repair or replacement due to failure by material and workmanship that prove defective within the above period, excluding refrigerant.

1.8 MAINTENANCE

A. Maintenance of the chillers shall be the responsibility of the owner and performed in accordance with the manufacturer's instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Daikin Applied

B. Motivair

C. Trane

D. AAON

2.2 UNIT DESCRIPTION

A. Provide and install as shown on the plans factory-assembled, air-cooled scroll compressor chiller with remote evaporator in the quantity specified. Each outdoor section shall consist of hermetic trio scroll compressor sets (total of 6 compressors), air-cooled condenser section, microprocessor-based control system and all components necessary for controlled unit operation. A multi-circuit, direct expansion insulated evaporator shall be provided for remote location to be installed and piped to the outdoor unit by the installing contractor. Components shall be shipped with a holding charge of nitrogen.

B. Chiller shall be functionally tested at the factory to ensure trouble free field operation.

2.3 DESIGN REQUIREMENTS

A. Flow Range: The chiller shall have the ability to support variable flow range down to 40% of nominal design (based on AHRI conditions).

B. Operating Range: The chiller shall have the ability to control leaving chilled fluid temperature from 15F to 65F.

C. General: Provide a complete scroll compressor chiller system consisting of an outdoor compressor-condenser section and a remote indoor evaporator as specified herein and as

shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.02 and any local codes in effect.

D. Performance: Refer to the schedule of performance on the drawings. The chiller shall be capable of stable operation to a minimum percentage of full load (without hot gas bypass) of 17%. Performance shall be in accordance with AHRI Standard 550/590.

E. Acoustics: Sound pressure levels for the unit shall not exceed the specified levels. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

2.4 CHILLER COMPONENTS

A. Compressor

1. The compressors shall be sealed hermetic, scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads. The compressors shall be equipped with an internal module providing compressor protection and communication capability.

B. Evaporator

1. The evaporator shall be a compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates.

2. The evaporator shall be protected with an external, electric resistance heater plate and insulated with 3/4" (19mm) thick closed-cell polyurethane insulation. This combination shall provide freeze protection down to -20°F (-29°C) ambient air temperature.

3. The water-side maximum design pressure shall be rated at a minimum of 435 psig (3000 kPa). Evaporators shall be designed and constructed according to, and listed by Underwriters Laboratories (UL).

C. Condenser

1. Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct-drive fan motors. The fans shall be equipped with a heavy-gauge vinyl-coated fan guard. Fan motors shall be TEAO type with permanently lubricated ball bearings, inherent overload protection, three-phase,

direct-drive, 1140 rpm. Each fan section shall be partitioned to avoid cross circulation.

2. Coil shall be microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannels layered between the refrigerant manifolds. Tubes shall be 9153 aluminum alloy. Tubes made of 3102 alloy or other alloys of lower corrosion resistance shall not be accepted. Coils shall consist of a two-pass arrangement. Each condenser coil shall be factory leak tested with high-pressure air under water. Coils shall withstand 1000+ hour acidified synthetic sea water fog (SWAAT) test (ASTM G85-02) at 120°F (49°C) with 0% fin loss and develop no leaks.

D. Refrigerant Circuit

1. Each of the two refrigerant circuits shall include a replaceable-core refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), expansion valve, and insulated suction line.

2. Each of the two refrigerant circuits shall include a replaceable-core refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), expansion valve, and insulated suction line.

E. Construction

1. Unit casing and all structural members and rails shall be fabricated of pre-painted or galvanized steel. Painted parts shall be able to meet ASTM B117, 1000-hour salt spray test.

2. Upper condenser coil section of unit shall have protective, 12 GA, PVC-coated, wire grille guards.

F. Control System

1. A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Box shall be designed in accordance with NEMA 3R rating. Power and starting components shall include factory circuit breaker for fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.

2. Shall include optional single-point connection to a non-fused disconnect switch with through-the-door handle and compressor circuit breakers.

G. Unit Controller

1. An advanced DDC microprocessor unit controller with a 5-line by 22-character liquid crystal display provides the operating and protection functions. The controller shall take preemptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:

2. The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.

3. Shutdown Alarms

   a. No evaporator water flow (auto-restart).
   b. Sensor failures.
   c. Low evaporator pressure.
   d. Evaporator freeze protection.
   e. High condenser pressure.
   f. Outside ambient temperature (auto-restart).
   g. Motor protection system.
   h. Phase voltage protection (Optional).

4. Limit Alarms

   a. Condenser pressure stage down, unloads unit at high discharge pressures.
   b. Low ambient lockout, shuts off unit at low ambient temperatures.
   c. Low evaporator pressure hold, holds stage #1 until pressure rises.
   d. Low evaporator pressure unload, shuts off one compressor.

5. Unit Enable Section

   a. Enables unit operation from either local keypad, digital input, or BAS.

6. Unit Mode Selection

    a. Selects standard cooling, ice, glycol, or test operation mode.

7. Analog Inputs:

    a. Reset of leaving water temperature, 4-20 mA\.
    b. Current Limit.

8. Digital Inputs

    a. Unit off switch.
    b. Remote start/stop.
    c. Flow switch.
    d. Ice mode switch, converts operation and setpoints for ice production.
    e. Motor protection.

9. Digital Outputs

    a. Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared.
    b. Evaporator pump; field wired, starts pump when unit is set to start.

10. Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

11. Building Automation System (BAS) Interface.

    a. Factory mounted DDC controller(s) shall support operation on a BACnet® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.
    b. BACnet MS/TP master (Clause 9).
    c. BACnet IP, (Annex J.).
    d. BACnet ISO 8802-3, (Ethernet).
    e. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
    f. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol

Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.5 OPTIONS AND ACCESSORIES

A. The following options are to be included:

1. High Ambient Control Panel for operation from 105°F up to 125°F ambient temperatures.

2. Phase loss with under/over voltage protection and with LED indication of the fault type to guard against compressor motor burnout.

3. Compressor Sound Reduction - Acoustic reduction blankets shall be factory installed on each compressor.

4. The following accessories are to be included:

a. Spring vibration isolators for field installation.
b. Field-mounted, paddle type, chilled water flow switch field wired to the control panel.
c. Items called for in schedule

B. Optional Factory-Installed Pump Package: None.

PART 3 - EXECUTION

3.1 CHILLER INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. General:

1. Obtain installation and wiring diagrams, piping diagrams, etc., from manufacturer.

2. Set chiller unit on proper vibration isolation equipment. Install precisely according to vibration isolator manufacturer's installation details.

3. Providing piping, valves and accessories to connect flow switches, oil piping, and other miscellaneous special devices or piping required for actual machine selected; obtain exact requirements from manufacturer of equipment before submitting bid.

4. Install thermometers, flexible connectors**,** drain valves and pressure gauges at all inlets and outlets.

5. Coordinate work in area adjacent to machine to insure adequate clearances for operating and service, as well as tube pulling space.

6. Prevent freeze-up from any cause.

7. Insulate completely as recommended by manufacturer those areas of unit not factory insulated.

C. Piping Connections:

1. Use flexible connectors at chilled water connections.

2. Verify chilled water IN and OUT, before piping.

3. Install thermometer wells, flow switches, pressure gauges, etc. as directed by manufacturer.

4. Provide refrigerant piping, sized and routed as per the chiller manufacturer's recommendations, if evaporator is remote mounted.

5. Install thermometers in all entering and leaving water piping.

6. Install all necessary air vents, drains, controls, and auxiliary piping or accessories.

3.2 ELECTRIC WIRING

A. Electrical Contractor shall provide all power wiring to chiller.

B. HVAC Contractor shall provide all control wiring at chiller, including flow switches, pressure switches, control circuit transformer, etc.

3.3 ACCESSORIES

A. Install accessories which are not factory mounted.

END OF SECTION

SECTION 237219 - ENERGY RECOVERY UNIT

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 SUMMARY

A. This section includes Air-to-Air Energy Recovery Ventilators for rooftop installation.

B. Within this document, these units may be referred to as Energy Recovery Ventilator (ERV) for brevity.

1.3 SUBMITTALS

A. Product data: For each type or model of Energy Recovery Ventilator, include the following:

1. Unit performance data for both Supply Air and Exhaust Air, with system operating conditions indicated.

2. Enthalpy plate performance data for both summer and winter operation.

3. Motor ratings and unit electrical characteristics.

4. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.

5. Estimated gross weight of each installed unit.

6. Filter types, quantities and sizes.

7. Installation, Operating and Maintenance manual (IOM) for each model.

B. Shop drawings: For air-to-air energy recovery ventilators, 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. Operation and maintenance for air-to-air energy recovery ventilator.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain Air-to-Air Energy Recovery Ventilator with all appurtenant components or accessories from a single manufacturer.

B. For the actual fabrication, installation and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.

C. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten (10) years from the date of purchase. The balance-of-unit shall be warranted to be free if manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two (2) years from the date of installation.

D. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL standard 723.

E. Certifications:

1. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacturer's published performance for air flow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI certified will not be accepted. OACF shall be no more than 1.02 and EATR shall be at 0% against balanced airflow.

2. Units intended for outdoor use shall be rain tested in accordance with UL 1812 Section 67.

F. Every unit to be factory tested prior to shipping: Motor Dielectric Voltage-Withstand Bench Test, Unit Dielectric Voltage-Withstand Test, Continuity of Internal Control Circuits Test, Unit Amperage Test.

1.5 COORDINATION

A. Coordinate size and location of all building penetrations required for installation of each Energy Recovery Ventilator and associated electrical systems.

B. Coordinate sequencing of construction for associated plumbing, HVAC, electrical supply.

C. Coordinate sizes and locations of roof curbs, equipment supports and roof penetrations with actual equipment provided.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:

1. RenewAire.

B. Manufacturer should be in business for minimum 10 years manufacturing energy recovery ventilators.

2.2 MANUFACTURED UNITS

A. Air-to-Air Energy Recovery Ventilators shall be fully assembled at the factory and consist of a fixed-plate cross-flow heat exchanger with no moving parts, an insulated double wall, G90 galvanized, 20-gauge steel cabinet, outdoor air hood with bird screen, motorized outside air intake damper, filter assemblies for both intake and exhaust air, enthalpy core, supply air blower assembly, motorized return air damper, exhaust air hood, exhaust air blower assembly and electrical control box with all specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection. Entire unit with the exception of field-installed components shall be assembled and test operated at the factory.

2.3 CABINET

A. Materials: Formed double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.

B. Outside casing: 20-gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Painted components as supplied by the factory shall have polyester urethane paint on 20 gauge G90 galvanized steel.

C. Access doors shall be hinged with airtight closed cell foam gaskets. Door pressure taps, with captive plugs, shall be provided for cross-core pressure measurement allowing for accurate airflow measurement.

D. Unit shall have factory-installed duct flanges on all openings.

E. Cabinet insulation: Unit walls an doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high density fiberglass board insulation, providing a clean able surface and eliminating the possibility of exposing the fresh air to glass fibers, and with a minimum R-value of 4.3 (hr-ft²-°F/BTU).

F. Enthalpy core: Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed. The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing. The energy recover core shall have a ten year warranty. Performance criteria are to be as specified in AHRI Standard 1060.

G. Control center/connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections to the non-fused disconnect.

H. Passive Frist Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

I. Motorized Isolation Damper(s): Return Air and Outside Air motorized dampers of an AMCA Class I low leakage type shall be factory installed.

2.4 BLOWER SECTION

A. Blower section construction, Supply Air and Exhaust Air: Blower assemblies consist of a 208-230V 1 Phase 60 HZ, ECM motor, and a direct driven forward-curved blower.

B. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

2.5 MOTORS

A. Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and shall be supplied with factory installed motor starters. Direct drive models (EV450 and HE1X models) shall be EISA-compliant for energy efficiency with open drip proof design and integral thermal protection.

2.6 CONTROLS:

A. Controls to be furnished and unit mounted.

1. Central control box mounted on the unit to include fused disconnects, fan magnetic motor starters, terminals and necessary transformers for system operation.

2. 120 volt service outlet on the unit panel.

B. Refer to "Control Systems" Section for additional requirements.

C. Capacity as called for.

D. Design equipment: RenewAire HE2XRTH

E. Make: Jackson & Church, "Z" Duct (Deschamps Laboratories, Inc.) or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Location as called for.

B. Provide in strict accordance to manufacturer's instructions.

C. Locate and orient unit to provide the shortest and most straight duct connections. Provide service clearances as indicated on the plans. Locate units distant from sound critical occupancies.

D. Install a structurally sound, weathertight, level and properly insulated roof curb with nailers, curb gasket and tie-downs to meet local wind requirements.

E. Insure roof decking penetrations inside curb are properly positioned and sized for ducts. Seal all penetrations and gaps between ducts and decking with appropriate fire, weather and acoustic sealant system.

F. Install fiberglass batt insulation over the decking inside the curb. Insulation thickness to be determined by local thermal requirements.

G. Use proper rigging, including spreader bars, for safe lifting and placement.

H. Provide spring type vibration rails or curb to match the specific unit corner weights.

I. Provide flexible duct connections at unit duct flanges.

J. All ductwork shall be designed, constructed, supported and sealed in accordance with SMACNA HVAC Duct Construction Standards and pressure classifications.

K. Ductwork shall be installed to the curb duct adaptors before unit is set in place.

L. Both the return and the supply ducts shall be thermally insulated at levels appropriate to the local climate from the unit through the curb and continuous until at least the first elbow or tee. A continuous vapor barrier shall also be provided on warm surface of the insulation.

END OF SECTION

SECTION 237413.10 - PACKAGED ROOFTOP UNIT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment, and services as required for the complete installation as shown on the Contract Documents.

1.2 SUBMITTALS

A. Submit unit performance data including: capacity, nominal and operating performance.

B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.

C. Submit shop drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.

D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

1.3 QUALIFICATIONS

A. Complete unit and accessories shall comply with the New York State Energy Conservation Construction Code. Unit shall have UL and AGA label.

1.4 MANUFACTURER'S WARRANTY

A. Provide parts warranty (excluding refrigerant) for one year from start-up or 18 months from shipment, whichever occurs first.

B. Provide five (5) year extended warranty for compressors.

C. Provide five (5) year heat exchanger limited warranty.

PART 2 - PRODUCTS

2.1 PACKAGED ROOFTOP UNITS

A. General:

1. Units shall conform to ANSI Z21.47/UL1995 for construction of packaged air conditioner.

2. The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

3. Units furnished and installed shall be packaged rooftops as scheduled on contract documents and these specifications. Cooling capacity ratings shall be based on

ARI Standard 210. Units shall consist of insulated weather-tight casing with compressors, air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit controls and drives.

4. Units shall be 100% factory run tested and fully charged with R-410A.

5. Units shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

6. Units shall be dedicated down flow or dedicated horizontal airflow as manufactured.

7. Wiring internal to the unit shall be colored and numbered for identification.

B. Unit Casing:

1. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18-gauge with access doors and removable panels of minimum 20 gauge.

2. Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.

3. Cabinet construction shall allow for all service/maintenance from one side of the unit.

4. Cabinet top cover shall be one-piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.

5. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section. Access panels shall be hinged.

6. Units base pan shall have a raised 1-1/8 in. high lip around the supply and return openings for water integrity.

7. Insulation: Provide 1/2 in. thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.

8. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.

9. Provide through-the base electrical power and control service; eliminating the need for separate roof penetrations.

10. Provide through-the-base gas piping including a pre-assembled black steel piping, manual gas shutoff valve (with 1/8 in. NPT pressure tap), elbows and union.

11. The base of the unit shall have three (3) sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

C. Air Filters:

1. Factory installed filters shall mount integral within the unit and shall be accessible through access panels. 2 in. thick pleated MERV 8 filters shall be furnished and installed.

D. Fans and Motors:

1. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.

2. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.

3. Provide units 5 tons and below with direct drive, multiple-speed, dynamically balanced supply fans.

4. Provide units 3-5 tons with belt driven supply fans with adjustable motor sheaves.

5. Provide units 6 tons and above with belt driven, supply fans with adjustable motor sheaves.

6. Outdoor and indoor fan motors shall be permanently lubricated and have internal thermal overload protection.

7. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.

8. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

E. Gas Fired Heating Section:

1. Completely assembled and factory installed heating system shall be integral to unit, UL or CSA approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Threaded connection with plug or cap provided. Provide capability for gas piping through the side of the unit.

2. Heating section shall be factory run tested prior to shipment.

3. Induced draft combustion type with direct spark ignition system, redundant main gas valve, and 2-staged heat.

4. Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision. Provide flame rollout switches.

5. Induced draft blower shall have combustion air proving switches and built-in thermal overload protection on fan motor.

6. Heat Exchanger: Provide tubular section type constructed from 18-gauge aluminized steel.

7. Burners: Burners shall be of the in-shot type constructed of stainless steel.

8. Limit controls: High temperature limit controls will shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow or loss of indoor airflow.

F. Evaporator Coil:

1. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.

2. Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 450 psig and leak tested at 200 psig.

3. Provide factory installed thermal expansion valve (TXV) for each refrigerant circuit. Factory pressure tested at 450 psig and leak tested at 200 psig.

4. Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.

G. Condenser Section:

1. Provide internally finned seamless copper tube mechanically bonded to configured aluminum fins. Factory pressure test to 450 psig.

2. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

3. Condenser coil shall be epoxy coated.

H. Refrigeration System:

1. Compressors: Provide direct drive, hermetic type, scroll compressor with centrifugal type oil pump. Motor shall be suction gas cooled and have internal spring isolation. Compressors shall include crankcase heaters, internal pressure relief, temperature and current sensitive overloads.

2. Units shall have cooling capabilities down to 0 degree F as standard. For field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.

3. Provide each unit with refrigerant circuits factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.

4. Refrigeration System Options:

   a. Thermal expansion valve.

   b. Dehumidification (hot-gas reheat) option.

   c. High-pressure refrigeration control.

   d. Frostat.

   e. Crankcase Heater.

I. Exhaust/Return Section

1. Provide a factory supplied field installed power exhaust assembly that shall assist the barometric relief damper in the economizer in relieving building pressurization.

J. Outdoor Air Section:

1. Provide a fully integrated field-installed 100% modulating outside air economizer with unit return and barometric relief air dampers, minimum position setting, preset linkage, wiring harness with plug. Unit operation is through primary temperature controls that automatically modulate dampers to maintain space temperature conditions.

K. Operating Controls:

1. Provide factory-wired roof top units with 24 volt control circuit with control transformers, contactor pressure lugs or terminal block for power wiring. Contractor to provide field-installed unit-mounted disconnect switch. Units shall have single point power connections. Field wiring of zone controls to be NEC Class II.

2. Provide microprocessor unit-mounted DDC control which when used with an electronic zone sensor provides proportional integral room control. This UCM shall perform all unit functions by making all heating, cooling, and ventilating decisions through resident software logic.

3. Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

4. Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.

5. Economizer Preferred Cooling: Compressor operation shall be integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.

6. Control Options:

   a. LonTalk communication interface.

   b. Fan failure switch.

   c. Dirty filter switch.

   d. Return air smoke detector.

   e. Ventilation override accessory: set to 3 different pre-programmed sequences for smoke purge, pressurization, and exhaust.

L. Staging Controls:

1. Provide NEC Class II, electronic, adjustable zone control to maintain zone temperature setting.

2. Provide manual/automatic changeover control with (off-heat-auto-cool), and fan control switch (auto-on).

3. Provide controller for by-pass VAV operation on constant volume rooftop that has been tested and supplied by HVAC equipment manufacturer. If by-pass VAV dampers are substituted and are not provided by the manufacturer, then it is the responsibility of the mechanical contractor to prove to the engineer that the complete system is compatible and operates properly.

4. Provide programmable electronic microcomputer based zone control.

M. Roof Curb:

1. Contractor shall provide factory supplied roof curb, 16-gauge perimeter made of zinc-coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly

2. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

N. Design Equipment: Daikin

O. Make: Carrier, Daikin Applied, Trane, York.

PART 3 - EXECUTION

3.1 PACKAGED ROOFTOP UNIT

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units from physical damage. Leave factory-shipping covers in place until installation.

C. Contractor shall verify that proper power supply is available.

D. Provide for roof openings and framing as called for. Set and secure curb to roof, and unit to curb. Shim roof curb level.

E. Pipe coil drains to spill to roof, provide "P" trap of proper depth.

F. Install unit in strict accordance with manufacturer's instructions.

G. Arrange to have equipment manufacturer's technician to verify installation for compliance with manufacturer's recommendations.

H. Arrange to have equipment manufacturer's technician perform start-up of equipment, instruct Owner's Representative in the proper operation of the equipment.

END OF SECTION

SECTION 238126.11 - DUCTLESS SPLIT SYSTEM AIR CONDITIONER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, equipment and services as required for the complete installation designed in Contract Documents.

1.2 SUBMITTALS

A. Submit product data for split system ductless air conditioner, including condensing unit, refrigerant piping diagrams, and control and wiring schematics.

1.3 GENERAL REQUIREMENTS

A. Provide units to fit intended use and location as indicated:

1. Capacity, size and arrangement, component parts and accessories as scheduled and/or as necessary to obtain required results and allow for proper maintenance.

2. Unit capacities to be ARI 210 rated.

3. Unit to meet or exceed minimum SEER Requirements of New York State Energy Code and Department of Energy (DOE).

PART 2 - PRODUCTS

2.1 AIR HANDLING UNIT WALL MOUNTED TYPE

A. Units shall be completely factory assembled including coil, condensate drain pan, fan, motor, filters and controls in an insulated casing. Units shall be UL listed and C.S.A. certified. Forward curved, dynamically and statically balanced fan with 3 speed direct drive. Fan motor bearing shall be permanently lubricated.

B. Units shall have sheet metal and steel frame construction and shall be painted with an enamel finish. Casing shall be insulated and knockouts shall be provided for electrical power and control wiring.

C. Unit shall have a single refrigerant circuit controlled by a flow control check valve (FCCV). Aluminum fin surface shall be mechanically bonded to 3/8 in. OD copper tubing. Coils shall be factory pressure and leak tested.

2.2 CONDENSING UNIT

A. The condensing unit shall be fully charged from the factory for up to 100 ft. of piping. The unit must be designed to operate at outdoor ambient temperatures as high as 115°F and as low as -20°F, with low-ambient kit. The unit shall be UL listed. Unit casing shall be constructed of heavy gauge, galvanized steel and painted with a weather-resistant powder paint finish.

B. Refrigeration system controls include condenser fan and compressor contactor. High and low pressure controls shall be inherent to the compressor. A factory installed liquid line dryer shall be standard. The compressor shall feature internal over temperature and pressure protection, total epoxy dipped hermetic motor windings, thermostatically controlled sump heater, centrifugal oil pump, and internal spring mounts to reduce vibration and noise. The coil shall be continuously wrapped, corrosion resistant all aluminum glued with minimized brazed joints. The coil shall be 3/8 in. O.D. seamless aluminum glued to a continuous aluminum fin. The coil shall be protected on all four sides by louvered panels.

2.3 ACCESSORIES

A. Wall Mounted Microprocessor Controller:

1. Liquid crystal digital display indicating: Operating mode, setpoint temperature, room temperature, timer setting, fan speed and airflow direction.

2. Self diagnostic fault indication.

3. 24 hour on-off timer.

4. Previous setpoint memory feature.

B. Low ambient protection kit with wind baffle. Allow unit operation down to 0°F -20°F.

C. Auto restart following power failure.

D. Condensate drain hose.

E. Pre-charged uninsulated refrigerant piping lines.

2.4 DESIGN EQUIPMENT

A. Mitsubishi.

2.5 ACCEPTABLE MAKE

A. Sanyo, Mitsubishi, EMI, Carrier.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in strict accordance with manufacturer's instructions and so as to be compatible with intent of the respective system performance requirements.

B. Connect condensate to piping left by Plumbing Contractor.

C. Provide refrigerant piping and control wiring.

D. Provide any and all necessary control wiring.

END OF SECTION

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services as required for the complete installation shown on Contract Drawings.

1.2 SUBMITTALS

A. Submit product data for room fan coil units and accessories.

PART 2 - PRODUCTS

2.1 GENERAL

A. Baked enamel finish of color selected from manufacturers standard colors. Each piece of equipment boxed separately and tagged by room number.

B. Coordinate voltages of valve and damper operators to be provided, with the DDC system controls subcontractor.

2.2 CONSOLE FAN COIL UNITS

A. Cabinets:

1. 18 gauge steel removable front enclosure so that internal operating parts are accessible for service or replacement.

2. Bar supply grilles.

3. Isolated valve compartment.

4. Access to motor, fan assembly, and filters.

5. Type as required for job conditions.

6. Return air grilles.

7. Insulated drip pan for coil and valve sections.

8. Insulated cabinet with material in compliance with NFPA 90A requirements.

B. Coils:

1. Copper tubes and headers, nonferrous fins.

C. Motors:

1. Multispeed, tapwound permanent split capacitor high efficiency type.

2. Built-in overload protection.

3. Resilient mountings to dissipate noise and magnetic vibration.

4. Quick detachable motor cords.

5. Permanently lubricated bearings.

D. Shall not exceed sound data as scheduled. Acoustical data is published manufacturer's data obtained by tests in accordance with ARI Standard 350-086.

E. Options:

1. Fresh air intake damper (where shown on plans) with manual damper

2. Keylock panel and access doors.

3. Manual air vent.

4. Disconnect switch.

5. 1 in. pleated throwaway filter.

6. Unit-mounted fan speed switch.

F. Design Equipment: Daikin.

G. Make: Carrier, Daikin Applied, Trane.

2.3 LOW PROFILE - RECESSED FAN COIL UNITS

A. Arrangement:

1. Base unit designed for fully recessed wall installation.

2. Features and accessories shall be the same as console type, except for the following:

a. Base casing shall be provided in lieu of finished cabinet. Return Grille.

b. Remote flush mounted speed switch shall be provided.

c. Maximum unit height 14 in.

d. Condensate pan.

B. Design Equipment: Daikin

C. Make: Carrier, Daikin Applied, Trane.

PART 3 - EXECUTION

3.1 GENERAL

A. Left hand or right hand piping connections for supply and return. Obtain complete instructions from unit manufacturer regarding each item and proper installation of same. Adjust motor speed.

3.2 INSTALLATION

A. In accordance with manufacturer's recommendations. Install piping within valve compartment to allow for pipe insulation. Provide drain piping. Vacuum clean inside of unit prior to operating units. Provide flexible duct connections at supply and return connections to ceiling units. For recessed and ceiling units, coordinate location of valves, fittings, filters, with access panels, to allow for convenient service of components.

END OF SECTION

SECTION 238239 - UNIT HEATERS AND CABINET UNIT HEATERS (HYDRONIC AND ELECTRIC)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services as required for the complete installation and related work as shown on the Contract Documents.

1.2 SUBMITTALS

A. Submit product data for unit heaters and cabinet unit heaters.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Free from expansion and contraction noises and strains. Fan speed shown on Schedule shall not be exceeded. Each piece of equipment shall be factory-boxed and tagged by room number. Cabinet unit heaters and unit heaters shall have baked enamel finish with color selected by the Architect from manufacturer's standard colors. Rating in accordance with standard test codes adopted jointly by IUGA and ASHRAE.

2.2 UNIT HEATERS

A. General:

1. Wall hung or ceiling suspended.

2. Access for servicing the heating element, motors, and controls.

3. Horizontal discharge units with adjustable horizontal and/or vertical outlet vanes.

4. Vertical units with adjustable outlet louvers or diffusers.

B. Fan and Motor:

1. Statically and dynamically balanced.

2. Motor shall be totally enclosed and designed for continuous operation. Lubrication shall be sealed-in, permanent type.

C. Heating Element (Hydronic):

1. Serpentine coil, copper tube, aluminum fins, back or side connections to fit headroom requirements.

2. Aquastat on return side to prevent fan operation when heat is not available.

D. Heating Element (Electric):

1. Nickel-chrome wire embedded in refractory encased in steel sheath with spiral wound steel fins.

2. Each element protected form overheating with high temperature limit switch of automatic reset, snap-action thermostat type.

3. Supporting brackets attached to back to provide longitudinal movement for expansion and contraction.

4. Magnetic contactors and other control devices to operate at 120 volt line voltage. Include manual disconnect switch, and transformer to provide 120 volt for controls and if necessary, for fan motor.

5. Fan delay switch to dissipate coil heat after element de-energized.

E. Control Accessories:

1. Unit mounted thermostat.

F. Hydronic:

1. Design Equipment: Sterling

2. Acceptable Makes: Daikin Applied, Airtherm, Dunham-Bush, Sterling, Trane, Vulcan.

G. Electric:

1. Design Equipment: Q-Mark.

2. Acceptable Makes: Berko, Markel, Q-Mark.

2.3 CABINET UNIT HEATERS

A. General:

1. Rough-in dimensions must not exceed those of design equipment.

B. Cabinet:

1. Front and exposed parts, 16-gauge furniture steel, all others, 18 gauge steel.

2. Fronts shall be removable for access to interior parts.

3. Recessed or semi-recessed equipment to have four-side overlap, trim strips not acceptable.

C. Fan And Motor:

1. Fans, forward curved, centrifugal type, direct drive from motor shafts.

2. Driven by totally enclosed motor with overload protection and lifetime lubrication.

a. Integral manual motor starter.

3. Shall be quiet in operation, not to exceed 45 db measured 5 ft. away, at high speed.

4. Throwawayfilter.

5. Key lock control access door(s).

D. Heating Element (Hydronic):

1. Nonferrous construction, copper tube, aluminum fins.

2. Multipass serpentine design for high temperature drop.

3. Manual air vent. Automatic air vent is not acceptable.

E. Heating Element (Electric):

1. Nickel-chrome steel resistance wire embedded in refractory enclosed in steel sheath with spiral wound fins.

2. High limit automatic reset cutout switch wired in series with each element to protect from overheating and located in discharge airstream.

3. Fan delay switch to keep fan in operation until heat in element is dissipated after element is de-energized.

4. Built-in transformer to convert line voltage current to fan, and control voltage if different from line voltage.

F. Control Accessories:

1. Wall mounted thermostat.

G. Hydronic:

1. Design Equipment: Sterling

2. Acceptable Makes: Airtherm, Daikin Applied, Dunham-Bush, Sterling, Trane, Vulcan.

H. Electric:

1. Design Equipment: Q-Mark.

2. Make: Berko, Markel, Q-Mark

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Provide equipment in accordance with manufacturer's printed instructions. Report untrue walls before installation. Report cases where clearance below suspended heaters is less than 7-1/2 ft. Provide clearance for piping or conduit. Support units independent of piping or conduit. Support units from building structure, with screws or bolts; no nailing allowed.

B. Be responsible for proper location and size of recesses. Coordinate installation of recessed or semi-recessed equipment in recesses. Provide framing in recess and shims. Use sponge rubber gasket air-seal between front enclosure and wall.

3.2 INSTALLATION - HYDRONIC

A. Provide valves and accessories and arrange to permit servicing. Coordinate correct end connections and coil arrangements.

B. Vertical cabinet heaters that are mounted on an existing wall shall be provided with continuous wood blocking that is painted to match the wall to infill any gaps created by the baseboard.

END OF SECTION

SECTION 238513 - REFRIGERATION VAPOR MONITORING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Refrigerant Vapor Monitoring System for Chiller Mechanical Room.

1.2 REFERENCES

A. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

B. ASHRAE 34 - Number Designation and Safety Classification of Refrigerants.

C. ACGIH - American Conference of Governmental Industrial Hygienists.

1.3 DEFINITIONS

A. Allowable Exposure Limit or Threshold Limit Value (AEL or TLV): The exposure for 8 hours per day, 40 hours per week, to which nearly all employees can be exposed - without harmful effect. Respiratory protection is recommended but not required.

B. Short Term Exposure Limit (STEL): 3 times the AEL or TLV. Limited exposure up to 30 minutes is allowed with respiratory protection required there after.

C. Emergency Exposure Limit (EEL): A concentration that a worker should only be exposed to rarely in a lifetime, but will not cause permanent adverse affects or interfere with escape. All occupants must exit the space upon attaining EEL. Respiratory protection required at all times when entering the space.

1.4 SYSTEM DESCRIPTION

A. Permanently mounted, continuously operating refrigerant vapor monitor, with remote sensor\transmitters when recommended by the manufacturer. Interfaced with both audible and visual alarms, the building direct digital control or energy management system, and start up of mechanical equipment room ventilation.

1.5 SUBMITTALS

A. Waiver of Submittals: The "Waiver of Certain Submittal Requirements" in Section 013300 does not apply to this Section.

B. Shop Drawings: Show location and spacing of monitors and sensors.

C. Product Data: Catalog sheets, specifications and installation instructions for the following item(s):

1. Refrigerant vapor monitor.

2. Remote sensor/transmitter units when required by manufacturer.

3. Calibration kit.

4. Alarm indicating appliances.

D. Quality Control Submittals:

1. Certificates: Affidavit required under Quality Assurance Article.

2. Installer's Qualifications Data:

a. Name of each person who will be performing the Work and their employer's name, business address and telephone number.

b. Names and addresses of three (3) similar projects that each person has worked on during the past five (5) years.

3. Company Field Advisor Data:

a. Name, business address and telephone number of Company Field Advisor secured for the required services.

b. Certified statement from the Company listing the qualifications of the Company Field Advisor.

c. Services and each product for which authorization is given by the Company, listed specifically for this project.

E. Contract Closeout Submittals:

1. Operation and Maintenance Data: Deliver two (2) copies, covering the installed products, to the Facilities Representative.

2. Test Reports:

a. Monitor Acceptance Test Report.

1.6 QUALITY ASSURANCE

A. Certification: Affidavit by the Company Field Advisor, certifying that the detection system meets the contract requirements and is operating properly.

B. Pre-Installation Conference: Before the monitoring system work commences, a conference will be held by the Facilities Representative at the Site for the purpose of reviewing the Contract Documents and discussing requirements for the Work. The conference shall be attended by the Contractor, the refrigerant monitor installers, and the Company Field Advisor.

C. Company Field Advisor: Secure the services of a Company Field Advisor for the following:

1. Render advice regarding installation and final adjusting of the monitor.

2. Render advice on the suitability of each monitor for this particular application.

3. Witness final acceptance test then certify with an affidavit that the monitor is installed in accordance with the Contract Documents and is operating properly.

4. Train facility personnel on the operation and or maintenance of the monitor and calibration equipment (Minimum of two (2) 3 hour sessions).

5. Explain available service programs to facility supervisory personnel for their consideration.

D. Qualifications: The person(s) installing the monitor system and their supervisor shall be personally experienced in monitor installation and have been regularly employed by a Company installing monitors for a minimum of five (5) years.

1.7 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping: Deliver monitor in factory applied protective cartons marked with sufficient identification for proper location.

B. Storage and Protection: Provide supplemental dehydrating devices within an enclosure or under a protective cover to control humidity. Maintain this protection from the time the monitor is manufactured until installed at the Site.

1.8 SCHEDULING

A. Ensure monitor system is fully operational prior to operating chillers.

1.9 MAINTENANCE

A. Maintenance Service: A fully equipped authorized service organization capable of guaranteeing response within 8 hours to service calls shall be available 24 hours a day, 7 days a week to service the completed work.

B. Extra Materials:

1. One (1) year supply of calibration gas and all necessary components to calibrate the monitor.

C. Special Tools:

1. Monitor Calibration Kit.

1.10 ACCEPTABLE MANUFACTURERS

A. MSA Instruments, Chillguard, Sentach, Vulcan, Honeywell.

PART 2 - PRODUCTS

2.1 REFRIGERANT VAPOR MONITOR

A. General: Continuously detect refrigerant R-410A and alarms when detected level rises (AEL or TLV) as per ASHRAE 15.

B. Features:

1. Three discreet alarm level setpoints: All values are refrigerant specific. Use values consistent with refrigerant being utilized in chiller or refrigeration system. Coordinate with chiller or refrigeration system manufacturer.

    a. (AEL or TLV) Allowable Exposure Limit or Threshold Limit Value.

    b. (STEL) Short Term Exposure Limit.

    c. (EEL) Emergency Exposure Limit.

2. Relays:

    a. Type: Form C single pole, double throw.

    b. Contacts:

        1) Rated for 5 amps resistive at 120 VAC.

        2) Selectable normally open or normally closed.

3. Relays to energize audible and visual flashing light alarm signals and interface with other equipment as follows:

    a. Audible and visual flashing alarm device in the mechanical equipment room, on or near the monitoring device.

    b. Outside entrance(s) to the mechanical equipment room. Visual flashing lights only.

    c. The facility direct digital control system.

4. Separate relay to energize mechanical ventilation upon alarm at (AEL or TLV), as per ASHRAE 15.

5. Separate relay to shut down gas engine driven chillers.

6. Monitor Malfunction Indicator: Indicates self diagnostic monitor failure and signals alarm condition at the monitor and to the building direct digital control system and energy management system.

7. Enclosures: NEMA 4 or 4X type with shatterproof window on the door of sufficient size to allow viewing displays and indicators on monitor front panel.

8. External Control: Switch accessible from the outside of the enclosure for temporarily silencing audible alarms.

9. Readout Display: LCD display for displaying gas concentration and self diagnostic failure codes.

10. Unit to be capable of monitoring four (4) separate zones.

2.2 ACCESSORIES

A. Remote Refrigerant Sensor:

1. Number, type and location of remote sensor/transmitters as recommended by the monitor manufacturer.

B. Calibration Kit: Type as recommended by the monitor manufacturer.

2.3 ALARM INDICATING APPLIANCES

A. General:

1. Remote audible and visual alarms shall be consistent with other warning devices in the building.

2. Audible and visual alarms interfaced with the building direct digital control system shall be consistent with other system audible and visual alarms.

3. UL listed.

4. 120 volt, 60 Hz.

5. Combination audible/visual alarms are acceptable.

B. Remote Audible Alarms: Located inside mechanical equipment room.

1. Horn to produce coded blast or sustained tone.

2. Fitted with single or double projector as recommended by the alarm manufacturer.

3. Rated at 99 dB minimum at ten feet.

C. Remote Visual Light Alarms: Located inside, and adjacent to main entrances to the mechanical equipment room.

1. Light duty warning type.

2. 360 degree rotating parabolic reflector or Xenon flash tube 360 degree strobe.

3. 60 flashes per minute or greater.

4. Shatter resistant Lexan dome or optic lens, color coded as follows:

a. Refrigerant Vapor Monitor:

1) (AEL or TLV) - Amber.

2) (STEL) - Red.

3) (EEL) - Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the work of this section in accordance with the manufacturer's printed installation instructions.

B. Mount monitor to the equipment room wall or to a free standing pedestal that is fastened to the floor. Mounting the monitor to a chiller or other equipment is not permitted.

C. Interface monitoring system with the following:

1. Air cooled scroll chiller.

2. Refrigeration system.

3. Building direct digital control system.

4. Mechanical ventilation exhaust fan.

3.2 FIELD QUALITY CONTROL

A. Preliminary System Tests:

1. Preparation: Have the Company Field Advisor adjust the completed system and then operate it long enough to assure that it is performing properly.

2. Run a preliminary test for the purpose of:

a. Determining whether the system is in a suitable condition to conduct the acceptance test.

b. Checking the adjusting equipment.

c. Training Facility personnel.

B. System Acceptance Test:

1. Preparation: Notify the Facilities Representative at least three (3) working days prior to the test so arrangements can be made to have a Facility Representative witness the test.

2. Perform the following tests:

a. Individually test monitor and associated signal initiating devices (remote sensor/transmitters).

b. Test alarm indicating appliances.

c. Test interface with mechanical ventilation.

d. Test interface with building direct digital control system and/or energy management system.

e. Demonstrate to the Facilities Representative that the system alarms correctly at the specified setpoints.

3. Supply equipment necessary for system adjustment, calibration and testing.

4. Submit a typewritten report of the test results, signed by the Company Field Advisor and the Facilities Representative. Enclose a copy of the report in a metal frame covered with plastic sheet glazing and mount adjacent to the monitor.

END OF SECTION

SECTION 260500 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, tools, materials, accessories, parts, transportation, taxes, and related items, essential for installation of the work and necessary to make work, complete, and operational. Provide new equipment and material unless otherwise called for. References to codes, specifications and standards called for in the specification sections and on the drawings mean, the latest edition, amendment and revision of such referenced standard in effect on the date of these contract documents. All materials and equipment shall be installed in accordance with the manufacturer's recommendations.

1.2 LICENSING

A. The Contractor shall hold a license to perform the work as issued by the authority having jurisdiction.

B. Plumbing contract work shall be performed by, or under, the direct supervision of a licensed master plumber.

C. Electrical contract work shall be performed by, or under, the direct supervision of a licensed electrician.

1.3 PERMITS

A. Apply for and obtain all required permits and inspections, pay all fees and charges including all service charges. Provide certificate of approval from the Authorities Having Jurisdiction prior to request for final payment.

B. Provide electrical inspection certificate of approval from Middle Department Inspection Agency, Commonwealth Inspection Agency, or an Engineer approved Inspection Agency prior to request for final payment.

1.4 CODE COMPLIANCE

A. Provide work in compliance with the following:

1. 2020 Building Code of New York State.
2. 2020 Fire Code of New York State.
3. 2020 Plumbing Code of New York State.
4. 2020 Mechanical Code of New York State.
5. 2020 Fuel Gas Code of New York State.
6. 2020 Property Maintenance Code of New York State.
7. 2020 Energy Conservation Code of New York State

8. Accessible and Usable Buildings and Facilities, ICC A117.1 (2009).
9. New York State Department of Labor Rules and Regulations.
10. New York State Department of Health.
11. 2017 National Electrical Code (NEC).
12. Occupational Safety and Health Administration (OSHA).
13. Local Codes and Ordinances.
14. Life Safety Code, NFPA 101.

1.5 GLOSSARY

ACI	American Concrete Institute
AGA	American Gas Association
AGCA	Associated General Contractors of America, Inc.
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AFBMA	Anti-Friction Bearing Manufacturer's Association
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing Materials
AWSC	American Welding Society Code
AWWA	American Water Works Association
FM	Factory Mutual Insurance Company
IBR	Institute of Boiler & Radiation Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association

NYS/DEC	New York State Department of Environmental Conservation
SBI	Steel Boiler Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UFPO	Underground Facilities Protective Organization
UL	Underwriter's Laboratories, Inc.
OSHA	Occupational Safety and Health Administration
XL - GAP	XL Global Asset Protection Services

1.6 DEFINITIONS

Acceptance	Owner acceptance of the project from Contractor upon certification by Owner's Representative.
As Specified	Materials, equipment including the execution specified/shown in the contract documents.
Basis of Design	Equipment, materials, installation, etc. on which the design is based. (Refer to the article, Equipment Arrangements, and the article, Substitutions.)
Code Requirements	Minimum requirements.
Concealed	Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.
Coordination Drawings	Show the relationship and integration of different construction elements and trades that require careful coordination during fabrication or installation, to fit in the space provided or to function as intended.
Delegated-Design Services	Performance and Design criteria for Contractor provided professional services. Where professional design services or certifications by a design professional are specifically required of a Contractor, by the Contract Documents. Provide products and systems with the specific design criteria indicated. If criteria indicated is insufficient to perform services or certification required, submit a written request for additional information to the Engineer. Submit wet signed and sealed certification by the licensed design professional for each product and system specifically assigned to the Contractor to be designed or certified by a design professional. Examples: structural maintenance ladders, stairs and platforms, pipe anchors, seismic compliant system, wind, structural supports for material equipment, sprinkler hydraulic calculations.
Equal, Equivalent, Equal To, Equivalent To, As Directed and As Required	Shall all be interpreted and should be taken to mean "to the satisfaction of the Engineer".
Exposed	Work not identified as concealed.
Extract	Carefully dismantle and store where directed by Owner's Representative

	and/or reinstall as indicated on drawings or as described in specifications.
Furnish	Purchase and deliver to job site, location as directed by the Owner's Representative.
Inspection	Visual observations by Owner's site Representative.
Install	Store at job site if required, proper placement within building construction including miscellaneous items needed to affect placement as required and protect during construction. Take responsibility to mount, connect, start-up and make fully functional.
Labeled	Refers to classification by a standards agency.
Manufacturers	Refer to the article, Equipment Arrangements, and the article, Substitutions.
Prime Professional	Architect or Engineer having a contract directly with the Owner for professional services.
Product Data	Illustrations, standard schedules, performance charts, instructions, brochures, wiring diagrams, finishes, or other information furnished by the Contractor to illustrate materials or equipment for some portion of the work.
Provide (Furnish and Install)	Contractor shall furnish all labor, materials, equipment and supplies necessary to install and place in operating condition, unless otherwise specifically stated.
Relocate	Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use.
Remove	Dismantle and take away from premises without added cost to Owner, and dispose of in a legal manner.
Review and Reviewed	Should be taken to mean to be followed by "for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents".
Roughing	Pipe, duct, conduit, equipment layout and installation.
Samples	Physical full scale examples which illustrate materials, finishes, coatings, equipment or workmanship, and establishes standards by which work will be judged.
Satisfactory	As specified in contract documents.
Shop Drawings	Fabrication drawings, diagrams, schedules and other instruments, specifically prepared for the work by the Contractor or a Sub-contractor, manufacturer, supplier or distributor to illustrate some portion of the work.
Site Representative	Owner's Inspector or "Clerk of Works" at the work site.
Submittals Defined (Technical)	Any item required to be delivered to the Engineer for review as requirement of the Contract Documents. The purpose of technical submittals is to demonstrate for those portions of the work for which a submittal is required, the manner in which the Contractor proposes to conform to the information given and design concepts expressed and required by the Contract Documents.

1.7 SHOP DRAWINGS/PRODUCT DATA/SAMPLES

A. Provide submittals on all items of equipment and materials to be furnished and installed. Submittals shall be accompanied by a transmittal letter, stating name of project and contractor, name of vendor supplying equipment, number of drawings, titles, specification sections (name and number) and other pertinent data called for in individual sections. Submittals shall have individual cover sheets that shall be dated and contain: Name of project; name of prime professional; name of prime contractor; description or names of equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Individual piecemeal or incomplete submittals will not be accepted. Similar items, (all types specified) shall be submitted at under one cover sheet per specification section (e.g. valves, plumbing fixtures, etc.). Number each submittal by trade. Indicate deviations from contract requirements on Letter of Transmittal. Submittals will be given a general review only. Corrections or comments made on the Submittals during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. If submitting hard copies, submit four (4) copies for review.

B. If submittals are to be submitted electronically, all requirements in Item A apply. Submittals shall be emailed in PDF format to specific email address provided by the Construction Manager, General Contractor, Architect or Project Manager. Name of project shall be in subject line of email. Send emails to mealbasubmittalclerk@meengineering.com.

C. Refer to Division 01 for additional requirements.

1.8 PROTECTION OF PERSONS AND PROPERTY

A. Contractor shall assume responsibility for construction safety at all times and provide, as part of contract, all trench or building shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, and other safety feature required to provide safe conditions for all workmen and site visitors.

1.9 EQUIPMENT ARRANGEMENTS

A. The contract documents are prepared using one manufacturer as the Basis of Design, even though other manufacturers' names are listed. If Contractor elects to use one of the listed manufacturers other than Basis of Design, submit detailed drawings, indicating proposed installation of equipment. Show maintenance clearances, service removal space required, and other pertinent revisions to the design arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger motors, feeders, breakers, and equipment, additional control devices, valves, fittings and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of roughing and connections by other trades. Remove and replace doorframes, access doors, walls, ceilings, or floors required to install other than Basis of

Design. If revised arrangement submittal is rejected, revise and resubmit specified Basis of Design item which conforms to Contract Documents.

1.10 SUBSTITUTIONS

A. If Contractor desires to bid on any other kind, type, brand, or manufacture of material or equipment than those named in specifications, secure prior approval. To request such approval, Contractor shall submit complete information comparing (item-for-item) material or equipment offered with design material or equipment. Include sufficient information to permit quick and thorough comparison, and include performance curves on same basis, capacities, power requirements, controls, materials, metal gauges, finishes, dimensions, weights, etc., of major parts. If accepted, an addendum will be issued to this effect ahead of bid date. Unless such addendum is issued, substitution offered may not be used.

1.11 UTILITY COMPANY SERVICES

A. Division 26 shall make arrangements with National Grid for electric service to the Owner's distribution equipment. Provide underground or overhead electric service as called for and transformers, meter sockets or meter compartments as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the electric service shall comply with the published Utility Company standards

B. Division 22 shall make arrangements with National Grid for gas service to the Owner's distribution system. Provide service to the building as required by the Utility Company. Coordinate all activities between the Owner and Utility Company. The installation of the gas service shall comply with the published Utility Company standards

1.12 ROUGHING

A. The Contract Drawings have been prepared in order to convey design intent and are diagrammatic only. Drawings shall not be interpreted to be fully coordinated for construction.

B. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Make necessary changes in contract work, equipment locations, etc., as part of a contract to accommodate work to avoid obstacles and interferences encountered. Before installing, verify exact location and elevations at work site. DO NOT SCALE plans. If field conditions, details, changes in equipment or shop drawing information require an important rearrangement, report same to Owner's Representative for review. Obtain written approval for all major changes before installing.

C. Install work so that items both existing and new are operable and serviceable. Eliminate interference with removal of coils, motors, filters, belt guards and/or operation of doors. Provide easy, safe, and code mandated clearances at controllers, motor starters, valve access, and other equipment requiring maintenance and operation. Provide new materials, including new piping and insulation for relocated work.

D. Coordinate work with other trades and determine exact route or location of each duct, pipe, conduit, etc., before fabrication and installation. Coordinate with Architectural Drawings. Obtain from Owner's Representative exact location of all equipment in finished areas, such as thermostat, fixture, and switch mounting heights, and equipment mounting heights. Coordinate all work with the architectural reflected ceiling plans and/or existing Architecture. Mechanical and electrical drawings show design arrangement only for diffusers, grilles, registers, air terminals, lighting fixtures, sprinklers, speakers, and other items. Do not rough-in contract work without reflected ceiling location plans.

E. Before roughing for equipment furnished by Owner or in other Divisions, obtain from Owner and other Divisions, approved roughing drawings giving exact location for each piece of equipment. Do not "rough in" services without final layout drawings approved for construction. Cooperate with other trades to insure proper location and size of connections to insure proper functioning of all systems and equipment. For equipment and connections provided in this contract, prepare roughing drawing as follows:

1. Existing Equipment: Measure the existing equipment and prepare for installation in new location.

2. New Equipment: Obtain equipment roughing drawings and dimensions, then prepare roughing-in-drawings. If such information is not available in time, obtain an acknowledgement in writing, then make space arrangements as required with Owner's Representative.

1.13 COORDINATION DRAWINGS

A. Before construction work commences, Divisions for all trades shall submit coordination drawings in the form of CAD drawing files, drawn at not less than 1/4 in. scale. Such drawings will be required throughout all areas, for all Contracts. These drawings shall show resolutions of trade conflicts in congested areas. Mechanical Equipment Rooms shall be drawn early in coordination drawing process simultaneous with all other congested areas. Prepare Coordination Drawings as follows:

1. Division 23 shall prepare the base plan CAD coordination drawings showing all ductwork, all pertinent heating piping, and equipment. These drawings may be CAD files of the required Ductwork Shop Drawings. The drawings shall be coordinated with lighting fixtures, sprinklers, air diffusers, other ceiling mounted items, ceiling heights, structural work, maintenance clearances, electric code clearance, reflected ceiling plans, and other contract requirements. Reposition proposed locations of work after coordination drawing review by the Owner's Representative. Provide adjustments to exact size, location, and offsets of ducts, pipes, conduit, etc., to achieve reasonable appearance objectives. Provide these adjustments as part of contract. Minor revisions need not be redrawn.

2. Division 23shall provide CAD files and submit the base plan CAD Coordination Drawings to all Divisions.

3. Divisions 21 and 22 shall draw the location of piping and equipment on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolutions.

4. Divisions 26, 27 and 28 shall draw the location of lighting fixtures, cable trays, and feeders over 1-1/2 in. on the base plan CAD Coordination Drawings, indicating areas of conflict and suggested resolution.

5. The General Construction Trade shall indicate areas of architectural/structural conflicts or obstacles on the CAD Coordination Drawings, and coordinate to suit the overall construction schedule.

6. The General Construction Trade shall expedite all Coordination Drawing work and coordinate to suit the overall construction schedule. In the case of unresolved interferences, he shall notify the Owner's Representative. The Owner's Representative will then direct the various trades as to how to revise their drawings as required to eliminate installation interferences.

7. If a given trade proceeds prior to resolving conflicts, then if necessary, that trade shall change its work at no extra cost in order to permit others to proceed with a coordinated installation. Coordination approval will be given by areas after special site meetings involving all Divisions.

B. The purpose of the coordination drawing process is to identify and resolve potential conflicts between trades, and between trades and existing or new building construction, before they occur in construction. Coordination drawings are intended for the respective trade's use during construction and shall not replace any Shop Drawings, or record drawings required elsewhere in these contract documents.

1.14 EQUIPMENT AND MATERIAL REQUIREMENTS

A. Provide materials that meet the following minimum requirements:

1. Materials shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less, in accordance with NFPA 255.

2. All equipment and material for which there is a listing service shall bear a UL label.

3. Potable water systems and equipment shall be built according to AWWA Standards.

4. Gas-fired equipment and system shall meet AGA Regulations and shall have AGA label.

5. Fire protection equipment shall be UL listed and FM approved.

B. Exterior and wet locations shall utilize materials, equipment supports, mounting, etc. suitable for the intended locations. Metals shall be stainless steel, galvanized or with baked enamel finish as a minimum. Finishes and coatings shall be continuous and any surface damaged or cut ends shall be field corrected in accordance with the manufacturer's recommendations. Hardware (screws, bolts, nuts, washers, supports, fasteners, etc.) shall be:

1. Stainless steel where the associated system or equipment material is stainless steel or aluminum.

2. Hot dipped galvanized or stainless steel where the associated system or equipment is steel, galvanized steel or other.

1.15 CUTTING AND PATCHING

A. Each trade shall include their required cutting and patching work unless shown as part of the General Construction Contract. Refer to General Conditions of the Contract for Construction, for additional requirements. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch cut or abandoned holes left by removals of equipment or fixtures. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

1.16 PAINTING

A. Paint all insulated and bare piping, pipe hangers and supports exposed to view in mechanical equipment rooms, penthouse, boiler rooms and similar spaces. Paint all bare piping, ductwork and supports exposed to the out-of-doors with rust inhibiting coatings. Paint all equipment that is not factory finish painted (i.e. expansion tanks, etc.).

B. All painting shall consist of one (1) prime coat and two (2) finish coats of non-lead oil base paint, unless otherwise indicated herein. Provide galvanized iron primer for all galvanized surfaces. All surfaces must be thoroughly cleaned before painting. Review system color coding prior to painting with the Owner's Representative or Architect.

C. All items installed after finished painting is completed and any damaged factory finish paint on equipment furnished under this contract must be touched up by the Contractor responsible for same.

D. Include painting for patchwork with color to match adjacent surfaces. Where color cannot be adequately matched, paint entire surface. Provide one (1) coat of primer and two (2) finish coats or as called for in the Specifications.

E. All primers and paint used in the interior of the building shall comply with the maximum Volatile Organic Compound (VOC) limits called for in the current version of U.S. Green Building Council LEED Credits EQ 4.1 and EQ 4.2.

F. Refer to Division 9 - Finishes, for additional information.

1.17 CONCEALMENT

A. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

1.18 CHASES

A. New Construction:

1. Certain chases, recesses, openings, shafts, and wall pockets will be provided as part of General Construction Trade. Mechanical and Electrical trades shall provide all other openings required for their contract work.

2. Check Architectural and Structural Design and Shop Drawings to verify correct size and location for all openings, recesses and chases in general building construction work.

3. Assume responsibility for correct and final location and size of such openings.

4. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.

5. Provide 18 gauge galvanized sleeves and inserts. Extend all sleeves 2 in. above finished floor. Set sleeves and inserts in place ahead of new construction, securely fastened during concrete pouring. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Firestop all unused sleeves.

6. Provide angle iron frame where openings are required for contract work, unless provided by General Construction trade.

1.19 PENETRATION FIRESTOPPING

A. Fire-Stopping for Openings Through Fire and Smoke Rated Wall and Floor Assemblies:

1. Provide materials and products listed or classified by an approved independent testing laboratory for "Penetration Fire-Stop Systems". The system shall meet the requirements of "Fire Tests of Penetrations Fire-Stops" designated ASTM E814.

2. Provide fire-stop system seals at all locations where piping, tubing, conduit, electrical busways/cables/wires, ductwork and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities which permit the easy removal or addition of electrical conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion, and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating.

5. Plastic pipe/conduit materials shall be installed utilizing intumescent collars.

6. Provide a submittal including products intended for use, manufacturer's installation instructions, and the UL details for all applicable types of wall and floor penetrations.

7. Fire-stopping products shall not be used for sealing of penetrations of non-rated walls or floors.

B. Acceptable Manufacturers:

1. Dow Corning Fire-Stop System Foams and Sealants.

2. Nelson Electric Fire-Stop System Putty, CLK and WRP.

3. S-100 FS500/600, Thomas & Betts.

4. Carborundum Fyre Putty.

5. 3-M Fire Products.

6. Hilti Corporation.

1.20 NON-RATED WALL PENETRATIONS

A. Each trade shall be responsible for sealing wall penetrations related to their installed work, including but not limited to ductwork, piping, conduits, etc. See individual specification sections for requirements.

1.21 SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, and other items to properly support contract work. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above.

B. For precast panels/planks and metal decks, support mechanical/electrical work as determined by manufacturer and the Engineer. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

C. For finished areas without a finished ceiling system such as classrooms, offices, conference rooms, etc., where decking and structure is exposed, and ductwork/piping/conduit is exposed: All mounting brackets, channel support systems and mounting hardware for ductwork, piping, lighting, etc. shall be concealed and approved by the Architect/Engineer prior to the installation. AirCraft cable style hanging for ductwork is required. It is recommended that room mockups be done and receive Architect/Engineer approval prior to proceeding with installation.

D. Equipment, piping, conduit, raceway, etc. supports shall be installed to minimize the generation and transmission of vibration.

E. Materials and equipment shall be solely supported by the building structure and connected framing. Gypboard, ceilings, other finishes, etc. shall not be used for support of materials and equipment.

1.22 ACCESS PANELS

A. Provide access panels for required access to respective trade's work. Location and size shall be the responsibility of each trade. Access panels provided for equipment shall provide an opening not smaller than 22 in. by 22 in. Panels shall be capable of opening a minimum of 90 degrees. Bear cost of construction changes necessary due to improper information or failure to provide proper information in ample time. Access panels over 324 square inches shall have two cam locks. Provide proper frame and door type for various wall or ceiling finishes. Access panels shall be equal to "Milcor" as manufactured by Inland Steel Products Co., Milwaukee, Wisconsin. Provide General Construction trade with a set of architectural plans with size and locations of access panels.

1.23 CONCRETE BASES

A. Provide concrete bases for all floor mounted equipment. Provide 3,000 lb. concrete, chamfer edges, trowel finish, and securely bond to floor by roughening slab and coating with cement grout. Bases 4 in. high (unless otherwise indicated); shape and size to accommodate equipment. Provide anchor bolts in equipment bases for all equipment provided for the project, whether mounted on new concrete bases or existing concrete bases.

1.24 HVAC EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide final connections to all equipment as required by the equipment. Provide final connections, including domestic water piping, wiring, controls, and devices from equipment to outlets left by other trades. Provide equipment waste, drip, overflow and drain connections extended to floor drains.

C. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, as required.

1.25 PLUMBING EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide roughing and final connections to all equipment. Provide loose key stops, sanitary "P" traps, tailpiece, adapters, gas or air cocks, and all necessary piping and fittings from roughing point to equipment. Provide installation of sinks, faucets, traps, tailpiece furnished by others. Provide cold water line with gate valve and backflow prevention device at locations called for. Provide continuation of piping and connection to equipment that is furnished by others. Provide relief valve discharge piping from equipment relief valves.

C. Provide valved water outlet adjacent to equipment requiring same. Provide equipment type floor drains, or drain hubs, adjacent to equipment.

D. Install controls and devices furnished by others.

E. Refer to Contract Documents for roughing schedules, and equipment and lists indicating scope of connections required.

F. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, as required.

1.26 ELECTRICAL EQUIPMENT CONNECTIONS

A. Provide complete power connections to all electrical equipment. Provide control connections to equipment. Heavy duty NEC rated disconnect ahead of each piece of equipment. Ground all equipment in accordance with NEC.

B. Provide for Owner furnished and Contractor furnished equipment all power wiring, electric equipment, control wiring, switches, lights, receptacles, and connections as required.

1.27 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

A. Store Materials on dry base, at least 6 in. aboveground or floor. Store so as not to interfere with other work or obstruct access to buildings or facilities. Provide waterproof/windproof covering. Remove and provide special storage for items subject to moisture damage. Protect against theft or damage from any cause. Replace items stolen or damaged, at no cost to Owner.

B. Refer to Division 01 for additional information.

1.28 FREEZING AND WATER DAMAGE

A. Take all necessary precautions with equipment, systems and building to prevent damage due to freezing and/or water damage. Repair or replace, at no change in contract, any such damage to equipment, systems, and building. Perform first seasons winterizing in presence of Owner's operating staff.

1.29 OWNER INSTRUCTIONS

A. Before final acceptance of the work, furnish necessary skilled labor to operate all systems by seasons. Instruct designated person on proper operation, and care of

systems/equipment. Repeat instructions, if necessary. Obtain written acknowledgement from person instructed prior to final payment. Contractor is fully responsible for system until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing. List under clear plastic, operating, maintenance, and starting precautions procedures to be followed by Owner for operating systems and equipment.

1.30 OPERATION AND MAINTENANCE MANUALS

A. Submit by email (preferred) or digital media, thru the normal project submittal process. Include a copy of each final approved Shop Drawing, wiring diagrams, piping diagrams, spare parts lists, final testing and balancing report, as-built drawings and manufacturer's instructions. Include typewritten instructions, describing equipment, starting/operating procedures, emergency operating instructions, summer-winter changeover, freeze protection, precautions and recommended maintenance procedures. Include name, address, and telephone number of installing contractor and of supplier manufacturer Representative and service agency for all major equipment items. Provide a table of contents page and dividers based upon specification section numbers. Submit in a compiled and bookmarked PDF format as outlined below.

B. Provide content for Operation and Maintenance Manuals as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer and Commissioning Agent will comment on whether content of operation and maintenance submittals is acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

C. Submit Operation and Maintenance Manuals in the following format:

1. Submit by uploading to web-based project software site, or by email to Architect, as a formal project submittal in conformance with the project specific submittal procedures. Enable reviewer comments on draft submittals.

2. 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.

3. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in the 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.

D. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing Owner training. Engineer and Commissioning Agent will comment on whether general scope and content of manual are acceptable.

E. Final Manual Submittal: Submit O&M manual in final form prior to requesting inspection for Substantial Completion and at least 2 weeks before commencing Owner training. Engineer and Commissioning Agent will return copy with review comments.

1. Correct or revise O&M manual to comply with Engineer's and Commissioning Agent's comments. Submit copies of each corrected manual within 2 weeks of receipt of Engineer's and Commissioning Agent's comments.

F. Refer to Division 01 for additional requirements.

1.31 RECORD DRAWINGS

A. The Contractor shall obtain at his expense one (1) set of construction Contract Drawings, (including non-reproduction black and white prints or electronic files) for the purpose of recording as-built conditions.

B. The Contractor shall perform all survey work required for the location and construction of the work and to record information necessary for completion of the record drawings. Record drawings shall show the actual location of the constructed facilities in the same manner as was shown on the bid drawings. All elevations and dimensions shown on the drawings shall be verified or corrected so as to provide a complete and accurate record of the facilities as constructed.

C. It shall be the responsibility of the Contractor to mark EACH sheet of the contract documents in red and to record thereon in a legible manner, any and all approved field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other changes shall also be maintained. At completion of the work, the complete set of red marked contract documents, plus all approved field sketches and diagrams shall be submitted to the engineer and used in preparation of the record drawings.

D. A complete set of red marked contract drawings shall be submitted, at one time, as the "Record" set. If there are no changes to a specific drawing, the contractor shall indicate "NO CHANGES" on that drawing. ALL drawings shall be included in the "Record" set.

E. The complete set of red marked Contract Documents or electronic files shall be certified by the Contractor as reflecting record conditions and submitted to the engineer for review.

F. The Contractor shall have the marked up set scanned, if they are not already electronic files, and then submit them to the Engineer as the "Record Set".

G. Refer to Division 01 for additional requirements.

1.32 FINAL INSPECTION

A. Upon completion of all Engineering Site Observation list items, the Contractor shall provide a copy of the Engineering Site Observation Report back to the Engineer with each items noted as completed or the current status of the item. Upon receipt, the Engineer will schedule a final review.

1.33 COMMISSIONING

A. Refer to General Commissioning Requirements in Division 01 for additional requirements.

1.34 TEMPORARY HEATING AND COOLING

A. Refer to the General Conditions of the Contract for Construction and Supplemental General Conditions.

1.35 MAINTENANCE OF HVAC SYSTEMS DURING TEMPORARY USE PERIODS

A. Provide each air handling system with a set of prefilters in addition to the permanent filters. Furnish four sets of prefilters for each system for use when system is operated for temporary heating or cooling. During such use, change prefilters as often as directed by Owner's Representative. Provide MERV-8 filters in all open ended ducts, return grilles and registers to keep dust out of ductwork. Change as often as necessary. Remove all such temporary filters upon completion. Use supply fans only. Do not operate return fans.

B. Blank-off outside air intake opening during temporary heating period. Install first set of permanent filters and prefilters.

C. Adjust dampers on supply system.

D. Set all heating coil control valves for manual operation.

E. Do not install any grilles or diffusers at room terminal ends of ducts until permission is given.

F. Assume responsibility for systems and equipment at all times, even though used for temporary heat or ventilating. Repair or replace all dented, scratched or damaged parts of systems prior to final acceptance.

G. Remove concrete, rust, paint spots, other blemishes, then clean.

H. Just prior to final acceptance, remove used final filter and install new set. Deliver all unused sets of prefilters to the Owner and obtain written receipt. Properly lubricate system bearings before and during temporary use. Maintain thermostats, freeze stats, overload devices, and all other safety controls in operating condition.

1.36 TEMPORARY FACILITIES

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.37 TEMPORARY LIGHT AND POWER

A. Refer to the Division 1 Sections, General Conditions and Supplemental General Conditions.

1.38 CLEANING

A. It is the Contractor's responsibility to keep clean all equipment and fixtures provided under this contract for the duration of the project. Each trade shall keep the premises free from an accumulation of waste material or rubbish caused by his operations. The facilities require an environment of extreme cleanliness, and it is the Contractor's responsibility to adhere to the strict regulations regarding procedures on the existing premises. After all tests are made and installations completed satisfactorily:

1. Thoroughly clean entire installation, both exposed surfaces and interiors.

2. Remove all debris caused by work.

3. Remove tools, surplus, materials, when work is finally accepted.

1.39 SYSTEM START-UP AND TESTING

A. Prior to commencement of work, the Division(s) effecting such system shall survey all building mechanical, plumbing, fire protection and electrical systems and components and make written notice to the Owner's Representative regarding any damage, missing items and/or incomplete systems. Prior to the conclusion of this project, the Contractor shall verify with the Owner's Representative that all building systems have been returned to their original conditions.

1.40 TRANSFER OF ELECTRONIC FILES

A. M/E Engineering, P.C. will provide electronic files for the Contractor's use in the preparation of sheetmetal shop drawings, coordination drawings, or record drawings related to the project, subject to a and the following terms and conditions:

1. The Contractor shall submit a formal request for electronic drawing files on the M/E Engineering, P.C. website, by utilizing the following website link: http://www.meengineering.com/contact-pages/contractor-request.

2. M/E Engineering, P.C. makes no representation as to the compatibility of these files with the Contractor's hardware or the Contractor's software beyond the specific release of the referenced specifications.

3. M/E Engineering, P.C. can only provide CAD files of M/E/P/FP drawing levels for which we are the Engineer of Record. CAD files of Architectural backgrounds, reflected ceiling plans, structural plans, etc. must be obtained separately from the Architect of Record.

4. Data contained on these electronic files is part of M/E Engineering, P.C.'s instruments of service shall not be used by the Contractor or anyone else receiving data through or from the Contractor for any purpose other than as convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by the Contractor or by others will be at the Contractor's sole risk and without liability or legal exposure to M/E Engineering, P.C. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against M/E

Engineering, P.C., its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with the Contractor's use of the electronic files.

5. Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless, M/E Engineering, P.C. from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from the Contractor's use of these electronic files.

6. These electronic files are not contract documents. Significant difference may arise between these electronic files and corresponding hard copy contract documents due to addenda, change orders or other revisions. M/E Engineering, P.C. makes no representation regarding the accuracy or completeness of the electronic files the Contractor receives. In the event that a conflict arises between the signed contract documents prepared by M/E Engineering, P.C. and electronic files, the signed contract documents shall govern. The Contractor is responsible for determining if any conflicts exist. By the Contractor's use of these electronic files the Contractor is not relieved of the Contractor's duty to comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, field verify conditions and coordinate the Contractor's work with that of other contractors for the project.

1.41 ENERGY INCENTIVES

A. The Contractor, his Subcontractors and Suppliers shall provide to the Owner all paperwork necessary to support the Owners pursuit of incentives related to energy conservation as offered by the utility company or state sponsored incentive programs. This shall include at a minimum, receipts, and quantities and data sheets for energy efficient equipment such as: lighting, motors, variable frequency drives, etc.

END OF SECTION

SECTION 260501 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The drawings are diagrammatic, unless detailed dimensioned drawings are included, and show only approximate locations of equipment, fixtures, panelboards, conduits, and wiring devices. Exact locations are subject to the approval of the Owner's Representative. The general run of electrical feeders, branch circuits, and conduits, indicated on the drawings, is not intended to be the exact routing. Exact routings of conduit shall suit the job conditions.

B. Circuit designations, in the form of "Home Runs" on branches, indicate the designation of the branch circuit, the size and the quantity of branch circuit conductors, and the panel board or interconnection box from which the branch circuit is served.

C. Make measurements at the site and in the building during construction for all systems installed as the work progresses in such a manner that the equipment, piping, vents, ducts, conduit, and boxes will fit in the space available. Maintain headroom and if in unfinished areas, be as neatly installed, as obscure and "out-of-the-way" as physically possible. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. In general, ductwork shall be given preference except where grading of piping becomes a problem, followed by piping then electrical wiring. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and /or furnish other equipment as required for ample maintenance space.

D. Any changes in the size or location of the material or equipment supplied, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Owner's Representative and approval received before such alterations are made.

1.2 QUALITY ASSURANCE

A. Electric equipment shall be installed in a neat and workmanlike manner. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative.

B. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc., correspond to the nomenclature dictated by those manufacturers. Where "or equal" is stated, equipment shall be equal in every way to that of the equipment specified and subject to approval. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

1.3 SUBMITTALS

A. Submit product data for the following equipment, materials and products, including all fittings and accessories:

1. Conduit
2. Surface Metal Raceway
3. Expansion Fittings
4. Wireway and Wire Trough
5. Channel Support Systems
6. Conductors
7. Poke-Through Service Fittings
8. Terminal and Equipment Cabinets
9. Flush Floor Boxes
10. Wiring Devices Including Dimmers
11. Telephone/Data Communication Outlets
12. Television Outlets
13. Occupancy/Vacancy Sensors
14. Lighting Control Contactors
15. Boiler Shutdown Switches
16. Underground Pullboxes (Handholes) and Covers
17. Manholes and Covers
18. Water Proofing Seals
19. Flashing, Sealing, Firestopping Materials
20. Testing reports prior to energizing equipment and materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit, Raceway and Tubing:

1. Rigid Metal Conduit shall be hot-dipped galvanized or electro-galvanized steel, UL listed "rigid metal conduit."

a. Acceptable Manufacturers:

1) Republic Conduit
2) Allied Tube and Conduit
3) Wheatland Tube Company
4) Approved equal

2. Electrical Metallic Tubing shall be electro-galvanized steel; UL listed "electrical metallic tubing."

a. Acceptable Manufacturers:

1) Republic Conduit
2) Allied Tube and Conduit
3) Wheatland Tube Company
4) Approved equal

3. Flexible Metal Conduit shall be constructed one continuous length of electro-galvanized, spirally wound steel strip with interlocking convolutions and interior surfaces free from burrs and sharp edges. Shall be UL listed "flexible metal conduit" or "liquidtight flexible metal conduit" as required.

    a. Acceptable Manufacturers:

        1) Republic Conduit
        2) Allied Tube and Conduit
        3) Wheatland Tube Company
        4) American Flexible Conduit Company

4. Rigid Non-Metallic Conduit (Schedule 40 for concrete encasement, Schedule 80 for direct burial or where exposed) shall be UL listed "rigid non-metallic conduit" for application in underground, encased, and exposed applications in accordance with Article 352 of the National Electrical Code. The conduit shall be made from polyvinyl chloride (PVC) and shall be rated for 90ºC conductors. Conduit and fittings shall be tested in accordance with the testing requirements defined in NEMA TC-2, NEMA TC-3, UL-651 and UL-514.

    a. Acceptable Manufacturers:

        1) Carlon
        2) Heritage Plastics
        3) PW Eagle

5. Surface Metal Raceway shall be .040 in. steel UL listed "Surface Metal Raceway". Use manufacturer's standard fittings designed to be used with the specific raceway.

    a. One-Piece Raceway:

        1) Buff or ivory finish.

        2) Acceptable Manufacturers:

            a) Wiremold "700" Series (Design Make)
            b) Mono Systems
            c) Approved equal

    b. Two-Piece Raceways:

        1) Ivory finish.

        2) Duplex or special receptacles as specified in wiring devices.

        3) Corners, turns, tees and elbows shall have suitable turning radius for the intended cable.

4) Provide divider in raceways utilized for power and communications. Utilize wire clips 18 in. on center to hold in the conductors/cables.

5) Utilize rounded head screws for mounting.

6) Acceptable Manufacturers:

a) Wiremold 6000 (Design Make)
b) Mono Systems
c) Approved equal

B. Conduit Fittings:

1. Fittings for rigid metal conduit shall be fully threaded and shall be of the same material as the respective raceway system. Fittings for electrical metallic tubing shall be single screw indenter fittings for conduits up to 2 in. and double screw indenter fittings for conduits 2 in. and larger. Connectors shall also have insulated throat up to and including 1 in. size. For sizes 1-1/4 in. and larger, provide plastic insulating bushing. Die-cast, pressure cast fittings shall not be used. Fittings for rigid non-metallic conduit shall be solvent cemented in accordance with the manufacturer's instructions.

a. Acceptable Manufacturers:

1) O.Z. Gedney
2) Steel City
3) Thomas & Betts
4) Crouse-Hinds
5) Carlon

2. Expansion Fittings shall be watertight, combination expansion and deflection type designed to compensate for movement in any direction. Fittings shall have flexible copper braid bonding jumpers, neoprene sleeve and stainless steel bands, use aluminum body fittings for rigid aluminum conduit.

a. Acceptable Manufacturers:

1) Crouse-Hinds, Type "DX"
2) O.Z./Gedney, Type "DX"
3) Approved equal

C. Wireway and Wire Trough:

1. Wireway and Wire Trough shall be hinged cover type wireway with provisions for full lay-in along the entire length of run. Wireway shall be steel, enclosed with gray enamel finish. Provide NEMA 1 units for interior/dry/clean locations and NEMA 12 for interior dry maintenance/shop/utility locations. Size to meet NEC fill requirements or larger as noted on Contract Documents. Provide knockouts along runs. Recess in wall where required for flush mounted equipment. Hinge shall be on the bottom of front face for horizontal mounting.

Provide all elbows, tees, pullboxes, fittings, hangers, reducers, supports, supports, etc., to meet installation requirements.

a. Acceptable Manufacturers:

1) Square D "Square Duct"
2) General Electric
3) Hoffman
4) Meco

D. Channel Support Systems:

1. Channel Support Systems shall be provided for racking of conduit, trapeze suspensions, equipment support, cable racks and panel racks. Provide poured-in-place inserts for supporting channels at poured concrete walls and ceilings. Channel shall be steel with electroplated zinc finish for interior dry locations. Provide necessary accessories such as bolts, screws, anchors, connection plates, and straps as required to perform the necessary functions. Wet location and exterior channel support systems shall be steel with hot dipped galvanized finish and stainless steel hardware as a minimum. Cut ends shall be touched up with suitable matching finish.

a. Acceptable Manufacturers:

1) Unistrut
2) Globe
3) Kindorf
4) B-Line

E. Conductors and Cables:

1. Conductors shall be insulated for 600 volts, unless otherwise noted, and shall be standard AWG and kcmil sizes. Conductors shall be 98% copper or 99.5% aluminum (#2AWG and larger), thermal plastic or cross-linked polymer insulated, heat and moisture resistant. Conductors shall be stranded, except for conductors used for fire alarm system wiring. Conductor sizes No. 18 AWG and smaller shall be a solid single strand; No. 16 AWG and larger shall be multiple stranded. Minimum conductor size shall be #12 AWG except smaller sizes may be used for communications and special systems. Conductor sizes shall be as called for. Conductors shall be labeled with UL seal and be marked with the manufacturer's name, wire size and insulation type. Insulation for all 600 volt conductors shall be Type THHN/THWN-2 for conductor sizes #8 AWG and smaller or Type XHHW-2 for conductor sizes #6 AWG and larger, unless otherwise noted. All exterior and underground conductors shall be XHHW-2. Luminaire fixture wire shall conform to the latest Underwriters Laboratories requirements. Flexible cords and cables for general portable use shall be Type SO or SOOW or as noted. Cables for special use shall be of the type specified for the application.

a. Color Coding:

1) All circuits shall be color coded according to the following schedule.

	Three Phase 120/208V 240V	**Three Phase 277/480V**
Ground	Green	Green
Neutral	White	Gray
A or L1	Black	Brown
B or L2	Red	Orange
C or L3	Blue	Yellow

b. Acceptable Manufacturers:

1) General Cable
2) Prysmian
3) South Wire
4) Okonite
5) Senator

2. Metal Clad, Type "MC" Cable shall consist of thermal plastic insulated copper conductors of size and quantity indicated, protected by a positive interlocked armor of galvanized steel. The conductors shall be twisted together and shall have an overall moisture and fire resistant fibrous covering. The cable shall provide an adequate path for equipment grounding as required by the NEC and have an integral green insulated full size equipment grounding conductor running its entire length. The cable shall meet the requirements of the NEC for "Type MC" Metal Clad Cable and shall bear the UL Label.

a. Acceptable Manufacturers:

1) Southwire
2) AFC Cable
3) Approved equal

F. Permanent Splices:

1. The shielded power cable splice must meet the requirements of ANSI/IEEE and meeting the cable voltage rating. It must be rated for continuous operation at 90ºC, with an emergency overload rating of 130ºC. The splice shall be made of peroxide cured EPDM rubber. The splice kit must contain all of the necessary materials required to make one inline splice (except for the connector), including a solderless mechanical ground jumper. The splice shall be designed for splicing tape shielded, wire shielded, and UniShield cables without the requirement of additional adapters. It shall be rated for indoor, outdoor and direct burial applications.

2. Acceptable Manufacturers:

a. 3M Brand

b. Elastimold
c. Raychem
d. Approved equal

G. Terminal Lugs and Connectors:

1. The copper lug shall be capable of continuous operation at the current rating of the cable it is used on. The lug shall be UL listed per UL 486A, using industry standard crimping tools and dies. Terminal lugs shall be solderless, pressure type with UL label for "CU/AL" conductor terminations. The lug shall be a closed-end compression (crimp) type, constructed of seamless, tin-plated copper. The lug shall be made with a chamfered inside end, for ease of conductor insertion. Both one and two hole lugs shall be NEMA sized for standard stud sizes and spacing. The lug shall be designed for use at voltages up to 35 kV.

   a. Acceptable Manufacturers:

      1) 3M Scotchlok 30,000 and 31,000 Series
      2) Burndy
      3) O.Z./Gedney
      4) Thomas and Betts

2. The copper conductor connection shall be capable of continuous operation at the current rating of the cables it is used on. The connection shall be UL listed per UL 486A, using industry standard crimping tools and ides. The connector shall be an inline compression (crimp) type, constructed of seamless, tin-plated copper. The connector shall be constructed with chamfered inside-ends and with center cable stops. The connector shall be designed for use at voltages up to 35 kV.

   a. Acceptable Manufacturers:

      1) 3M Scotchlok 10,000 and 11,000 Series
      2) Burndy
      3) O.Z./Gedney
      4) Thomas and Betts

3. "Split-bolt" Connectors shall be solderless type.

   a. Acceptable Manufacturers:

      1) Burndy
      2) Kearney
      3) O.Z./Gedney
      4) Thomas and Betts
      5) Anderson

4. "TWIST ON" Connectors shall be spiral steel spring type and insulated with vinyl cap and skirt.

   a. Acceptable Manufacturers:

1) 3-M Company "Scotch-Lok"
2) Ideal "Wing-Nuts"
3) Approved equal

H. Boxes:

1. Outlet boxes shall be galvanized steel, not less than 2-1/8 in. deep, unless restricted by the surroundings, 4 in. square or octagonal, with knockouts. Boxes and associated fittings, plates and devices shall be mechanically fastened (screwed), friction fitting is not acceptable. Outlet boxes exposed to moisture, exterior, wet or damp locations shall be cadmium cast alloy complete with external threaded hubs and gasketed screw fastened covers. Minimum box size shall be as indicated in the NEC for the conductors and devices installed. Boxes shall be approved for the environmental condition where they will be installed.

   a. Acceptable Manufacturers:

      1) Steel City
      2) Raco
      3) Appleton
      4) Crouse Hinds

2. Telephone/Data Communications Outlet Boxes:

   a. 4 in. x 4 in. x 2-1/8 in. minimum outlet box with single gang plaster ring with cover plate suitable for indicated communications outlet and conduit routed to accessible ceiling space. Cover plate shall match the receptacle cover type.

3. Pull and junction boxes shall be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type covers. Boxes installed in damp or wet locations shall be of raintight construction with gasketed cover and threaded conduit hubs. In no case shall boxes be sized smaller than as indicated NEC for conduit and conductor sizes installed. Boxes shall be approved for the environmental condition of the location where they will be installed.

   a. Acceptable Manufacturers:

      1) Hoffman
      2) Keystone
      3) Approved equal

4. Flush floor junction boxes shall be recessed cover boxes designed for flush mounting in masonry. Provide checkered plate gasketed cover suitable for foot traffic. Make: O.Z. Gedney Type YR or approved equal.

5. Flush Floor Boxes: Boxes shall be cast in place with height adjustability prior to pour. Provide power, communication and/or audio/visual outlets as indicated. Installation shall be suitable for the intended floor finish: if carpet, then provide a carpet flange, if tile/terrazzo/concrete finish, then provide a collar flush with

finished floor and no flange. Units shall meet UL scrub water protected requirements. To have integral ground terminal.

a. Acceptable Manufacturers:

1) Acceptable manufactures shall include the following and shall meet the requirements herein.

a) Wiremold - Evolution Series

b) Approved equal.

6. Flush Poke-Through Service Fitting (Power/Communication):

a. Provide flush poke-through suitable for installation in a cored floor opening. Shall be complete with junction box, conduit and flush devices as indicated on plans. The complete assembly shall be suitable for two hour fire rated floors, be UL CEYY listed and have UL scrub water protected metallic color as selected by the Architect and trim ring. Cover shall be suitable for carpet, tile, wood and concrete. Unit protrusion above floor plane shall not exceed 0.2". Extend or reduce unit raceway length as needed to accommodate floor thickness and project conditions. Provide indicated devices in units.

b. Acceptable Manufacturers:

1) Wiremold - Evolution Series
2) Approved equal

I. Terminal and Equipment Cabinets:

1. Terminal and equipment cabinets shall be code gauge galvanized steel with removable endwalls. Fronts shall be of code gauge steel, flush or surface type (as indicated) with concealed trim clamps, concealed hinges, flush lock, and grey baked enamel finish. Boxes and front shall be UL listed and shall be minimum 35 in. H x 24 in. W x 6 in. D. Provide removable insulated plywood terminal board mounted on inside back wall of cabinet.

a. Acceptable Manufacturer:

1) Square D "Mono-Flat"
2) Approved equal

J. Wiring Devices:

1. Wiring Devices (toggle switches, key switches, receptacles, dimmers, occupancy sensors, etc.) shall be specification grade as a minimum. Switch handle and receptacle face shall be as directed by the Architect. Provide device cover plates of satin finish type 302 stainless steel in finished areas and rounded raised (Steel City 450/460 series) only for surface mounted locations in unfinished areas. Provide neoprene gasketed cast aluminum/zinc box with hinged rain tight cast

aluminum/zinc lockable while in use cover with stainless steel hardware for devices designated "WP".

a. Acceptable Manufacturers:

1) Pass and Seymour
2) Hubbell
3) Leviton

2. Toggle/Snap Switches:

a. Units shall be quiet operation, quick make/quick break, rated for 20A/120-277V/1hp at 120/277V, side/back wired, with nylon/polycarbonate toggle, self-grounding mounting screw clip plate (not staple), ground terminal and silver alloy contacts. Units shall meet latest Federal Specification WS-896, NEMA WD-1 and UL Test 20. Single pole units shall be Hubbell HBL1221, P&S 20AC1 or Leviton 1221-2. Provide two pole, three way, four way, illuminated handle, keyed, etc. type of the same quality and model.

3. Receptacles:

a. Provide receptacles where indicated on the drawings and where called for. Provide type receptacle as indicated and if not indicated then utilize general receptacle.

b. General Receptacle: Units shall be NEMA 5-20R, duplex, 20A, 125V, side/back wired, #14 to 10AWG screw terminals with nylon face, indented brass contacts for three point connection, self-grounding mounting screw clip plate (not staple), ground terminal Meet requirements of Federal Specification W-C-596, NEMA WD-6 and UL 498.

1) Units shall be: Hubbell 5352, P&S CRB5362 or Leviton 5352.

c. Ground Fault Interrupting Receptacles: Units shall be as specified above for General Receptacle and have 5mA interrupting ground fault level, test/reset front buttons, full through feed capability, power off on reverse wired sensing, 10kA short circuit current rating, be tamper/weather resistant and in compliance with UL 943. Unit shall self-test function to periodically test the components automatically and indicate a failure condition utilizing an LED. Shall be Hubbell GFR5362, P&S 2096TR or Leviton S7599TR.

d. Dryer Receptacles: To be NEMA 14-30R single receptacle in suitable box and steel cover plate painted to match the surrounding. Shall be Hubbell, P&S or Leviton highest grade available.

e. Special Receptacles: provide other type receptacles as indicated herein or on the drawings. Such receptacles shall be Hubbell, P&S or Leviton highest grade available.

4. Lighting Dimmers:

   a. Provide lighting dimmer where indicated suitable for the type of luminaire for even continuous control. Unit shall be rated for the indicated connected load plus 25% minimum (even when ganged). Review luminaire schedule for type and loading. Provide for three-way control as indicated.

   b. Dimmers to be Lutron "Nova" NT-(1000W minimum) with debuzzing coil for incandescent.

   c. Low voltage dimming shall be as recommended by the luminaire manufacturer for magnetic or solid state.

   d. LED dimmers shall be as recommended by the luminaire manufacturer and be listed for use with the associated driver.

   e. Device color shall match the toggle switch.

   f. Acceptable Manufacturers:

      1) Lutron
      2) Approved equal

5. Television Outlets:

   a. 4 in. x 4 in. outlet box with single gang plaster ring with coax connector and plate and conduit routed to accessible ceiling space. Cover plate shall match the receptacle cover type.

6. Emergency Shutdown Pushbutton:

   a. Where called for provide emergency shutdown/emergency power off push button. Unit shall be Square D Class 9001 Type K NEMA 13 oil tight pushbutton with the following:

      1) Red mushroom head 1-1/2 in. button, hinged protective flip up cover, push to operate, pull to reset.

      2) Maintained contact operation with one normally open and one normally closed 10A 120V contacts. Provide relay for additional contacts.

      3) Red pilot light.

      4) Engraved legend plate indicating "XX - Emergency Stop" with XX = the system name.

7. Occupancy/Vacancy (Automatic/Manual) Sensors:

   a. Sensors shall comply with the following as a minimum:

1) Zero crossing switching operation (switch on/off only where sine wave is at zero volts) suitable for linear, non-linear and electronic/magnetic fluorescent ballasts for the loads indicated. Where the load to be controlled exceeds the sensor load rating provide a separate relay of adequate rating.

2) Failure of the unit shall be to the on/closed position or manual operation.

3) Motion sensitivity adjustment (dip switch or dial) and time delay adjustment (5 to 20 minutes minimum, dip switch or dial).

4) Line voltage input and switching. Field selectable for 120 or 277 VAC, 60 Hz.

5) UL listed and have a five (5) year manufacturer full replacement warranty.

6) Test mode feature to override the set time delay to allow adjusting of the sensitivity.

7) Sensor locations shall be adjusted during construction and at occupancy as recommended by the manufacturer for optimal sensing and operation.

8) Operation shall have adjustable time delay. Occupancy sensors shall have automatic on and vacancy sensors shall have manual on.

9) Adjustable controls/settings shall only be accessible when the front cover is removed or from the back of the unit.

10) Unit color shall match the project devices except for the ceiling mounted units which shall match the ceiling color. All color selections shall be by the Architect.

11) Ultrasonic sensing shall not be affected by air movement and shall operate at 32 kHz minimum (shall not interfere with hearing aids or other equipment).

12) Provide components as needed for the indicated control.

13) A factory authorized representative shall coordinate and instruct the start up services of the sensors providing placement recommendations, connection guidance and start up supervision and adjustment.

b. Wall Mounted - Passive Infrared (PIR):

1) Unit shall fit into a standard single gang electrical box, have an on/off button and utilize PIR technology motion sensing. Selectable manual or automatic on mode.

2) Minimum Switching Capacity: 120 V - 800 W, 277 V - 1200 W.

3) The sensing shall be 180° and the sensitivity area to be a minimum of:

a) Major Motion (Walking/Arm Wave): 35 ft. x 30 ft.

b) Minor Motion (Small Motion at Desk): 20 ft. x 15 ft.

4) Ambient light level sensing (adjustable 20-300 fc) to prevent "on" operation when the ambient light level is greater than the set point level.

5) High impact resistant sensor lens.

6) Acceptable Manufacturers:

a) Pass & Seymour Model OS300S (Design Make)
b) Hubbell
c) Watt Stopper
d) Sensor Switch

c. Wall Mounted - Dual Technology (PIR and Ultrasonic):

1) Unit shall fit into a standard single gang electrical box, have an on/off button and utilize PIR and ultrasonic technology motion sensing. Both types of sensing are needed for contact closure but only one is needed to keep it closed. Selectable manual or automatic on mode.

2) Minimum Switching Capacity: 120 V - 800 W, 277 V - 1200 W.

3) The sensing shall be 180° and the sensitivity area to be a minimum of:

a) Major Motion (Walking/Arm Wave): 35 ft. x 30 ft.

b) Minor Motion (Small Motion at Desk): 20 ft. x 15 ft.

4) Ambient light level sensing (adjustable 20-300 fc) to prevent "on" operation when the ambient light level is greater than the set point level.

5) High impact resistant sensor lens.

6) Acceptable Manufacturers:

a) Hubbell Model AD2000 (Design Make)
b) Watt Stopper
c) Cooper
d) Sensor Switch

d. Ceiling Mounted - Occupancy Sensor - Dual Technology:

1) Unit shall mount to standard octagonal box, have adjustable sensitivity/time delay, have auxiliary contact (form C, 0.5A at 24 VDC) and utilize PIR and ultrasonic technology motion sensing. Both types of sensing are needed for contact closure but only one is needed to keep it closed. Auxiliary contact shall indicate movement sensing and be selectable to utilize time delay or not.

2) Shall have self contained rated contacts or control a separate switch pack. If a self contained unit then the ratings and function shall meet or exceed the switch pack specifications.

3) Sensing shall be 360° with a minimum operating area of:

a) Major Motion (Walking/Arm Wave): 50 ft. x 30 ft.

b) Minor Motion (Small Motion at Desk): 40 ft. x 20 ft.

c) Corridor (Major Motion): 50 ft. x 16 ft.

4) Units shall be suitable for overlap of motion detection areas without reduction in spacing and false operation.

5) Sensing shall be suitable for a ceiling/mounting height of up to 12 ft. minimum.

6) The maximum depth shall be 1.5 in. below the ceiling/box.

7) Acceptable Manufacturers:

a) Hubbell Model ATD2000CRP (Design Make)
b) Watt Stopper
c) Cooper
d) Sensor Switch

e. Ceiling Mounted - Vacancy Sensor - Dual Technology:

1) Unit shall mount to standard octagonal box, have adjustable sensitivity/time delay, have auxiliary contact (form C, 0.5A at 24 VDC) and utilize PIR and ultrasonic technology motion sensing. Both types of sensing are needed for contact closure but only one is needed to keep it closed. Operation shall require manual operation of momentary wall switch for lighting to be switched on and automatic off. Auxiliary contact shall indicate movement sensing and be selectable to utilize time delay or not.

2) Shall have self contained rated contacts or control a separate switch pack. If a self contained unit then the ratings and function shall meet or exceed the switch pack specifications.

3) Sensing shall be 360° with a minimum operating area of:

a) Major Motion (Walking/Arm Wave): 50 ft. x 30 ft.

b) Minor Motion (Small Motion at Desk): 40 ft. x 20 ft.

c) Corridor (Major Motion): 50 ft. x 16 ft.

4) Units shall be suitable for overlap of motion detection areas without reduction in spacing and false operation.

5) Sensing shall be suitable for a ceiling/mounting height of up to 12 ft. minimum.

6) The maximum depth shall be 1.5 in. below the ceiling/box.

7) Provide momentary switch(es) and any other needed equipment for indicated operation.

8) Acceptable Manufacturers:

a) Hubbell Model ATD2000CRP (Design Make)
b) Watt Stopper
c) Cooper
d) Sensor Switch

f. Switch Pack:

1) Provide a minimum of one (1) switch pack for each ceiling mounted occupancy sensor. Provide additional units for multiple circuits (quantity to match the quantity of circuits).

2) Unit shall be plenum rated with line voltage side into a metallic box.

3) Low voltage power shall be suitable for a minimum of three (3) occupancy sensors. Multiple sensors shall be able to control a single switch pack.

4) Minimum switching capacity shall be 20A (all types of loads) at 120/277VAC.

g. Testing:

1) Each occupancy sensor shall be fully tested for proper operation of all functions after installation.

2) Testing shall include sensitivity, time delay, ambient lighting level, etc.

3) Operation and settings shall be acceptable to the Owner.

K. Underground Pullboxes (Handholes):

1. Sidewalk and Grass Areas: Boxes shall be comprised of composite material with stainless steel hardware and ANSI Tier 8 rating minimum. Provide conduit/duct openings per the plans/schematics with spare capacity for 2 - 2" in each side wall, minimum. Box shall be minimum 2'-0" wide x 2'-0" long x 3'-0" deep inside dimensions, or larger as required to meet NEC requirements. Cover shall be imprinted with either "Electric", "Telephone", etc. to designate type of service. Provide 18 in. of #2 crushed stone under pullbox and 18 in. beyond. Refer to drawings per details and locations.

a. Manufacturers:

1) Quazite
2) Old Castle
3) Approved equal

2. All Other Areas: Boxes shall have ANSI Tier 22 rating (22,500lb weight rating) and be comprised of steel reinforced concrete walls and bottom sections using 5,000 psi, minimum concrete. Bottom shall have 12 in. diameter sump opening and 3/4 in. ground rod opening. Knockouts and openings shall be positioned for conduits/ducts. Provide two (2) rows of anchor bolt inserts for cable rack supports to permit installation of two (2) cable rack supports on each side wall and one (1) cable rack support on each end wall. Provide hot dipped galvanized steel pulling irons at 45° angle between floor and wall opposite each opening. Provide 24 in. x 24 in. opening for frame and cover and a suitable masonry "Throat" between top of box and cover frame to allow for variation in final finished grade. Frame and cover shall be case iron. Provide 4 in. drain to local site daylight. Refer to drawings per details and locations.

a. Manufacturers:

1) Pullbox: Lakelands precast.
2) Cover: Neenah Foundry Company, roadway type.
3) Approved equal.

L. Ductbanks:

1. Ductbanks shall be rigid non-metallic conduit system. Provide all sleeve joints, couplings, bend sections, bends, elbows, offsets, angle couplings, bell ends, caps, base spacers and intermediate spacers as required to meet field conditions. All bends, stub-ups and wall, slab or floor-building penetrations shall be rigid steel conduit without exception.

M. Waterproofing Seals:

1. Provide expanding link type seal, for installation between duct/conduit, and sleeve or core-drilled hole in concrete.

2. Make: Link Seal, manufactured by Thunderline Corp., or approved equal.

N. Flashing, Sealing, Fire-stopping:

1. Fire-Stopping for Openings Through Fire and Smoke Rated Wall and Floor Assemblies:

a. Provide materials and products listed or classified by an approved independent testing laboratory for "Through-Penetration Fire-Stop Systems". The system shall meet the requirements of "Fire Tests of Through-Penetration Fire-Stops" designated ASTM E814.

b. Provide fire-stop system seals at all locations where piping, tubing, conduit, electrical busways/cables/wires, ductwork and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.

c. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.

d. The methods used shall incorporate qualities, which permit the easy removal or addition of electrical conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating.

2. Acceptable Manufacturers:

a. Dow Corning Fire-Stop System Foams and Sealants
b. Nelson Electric Fire-Stop System Putty, CLK and WRP
c. S-100 FS500/600, Thomas & Betts
d. Carborundum Fyre Putty
e. 3-M Fire Products

PART 3 - EXECUTION

3.1 INSTALLATION

A. Unless otherwise noted, wiring for all systems indicated in the contract documents shall consist of insulated conductors installed in raceways. Raceways shall be continuous from outlet box to outlet box and from outlet box to cabinet, junction or pull box. Secure and bond raceways to all boxes and cabinets so that each system of raceways is electrically continuous throughout. Unless otherwise indicated on the drawings, install all wiring in the following raceway system:

1. Wiring 600 Volts or Less in Dry Locations: Electrical metallic tubing or type MC cable.

2. Wiring 600 Volts or Less in Outdoors, Above Grade Locations: Rigid metal conduit.

3. Wiring 600 Volts or Less Installed Below Grade, in Concrete Floor Slabs or Below Ground Floor Slab: Rigid non-metallic conduit with rigid metal conduit bends and penetrations through building floors and walls.

4. Flexible metal conduit shall be used for final connection to all motors, final connection to rotating or vibrating equipment, final connections to dry type transformers and final connections to recessed lighting fixtures. Liquidtight flexible conduit shall be used in all wet or damp locations. Maximum length of flexible conduit shall be 36 in., except that from outlet boxes to lighting fixture maximum length shall be 6 ft. Provide green insulated equipment grounding conductor in all flexible metal conduit.

5. Surface metal raceway may be used for surface runs in finished area where concealed conduit cannot be run or where specifically indicated on drawings. Submit detailed description and/or layout for approval prior to roughing.

6. Where allowed, branch circuits may be type MC cable between homerun junction box and equipment/device connection in drywall partitions only. Homerun junction box to be a maximum of 20 ft. from equipment/device.

B. Raceways:

1. Sized as indicated on the drawings. Where sizes are not indicated, raceways shall be sized as required by the National Electrical Code in accordance with the quantity, size, and type of the insulation conductors to be installed. Raceways shall be minimum 1/2 in. trade size for branch circuit wiring and minimum 3/4 in. trade size for all telephone intercommunications, instrumentation, fire alarm, television and computer systems and for all branch circuit "Home Runs" to panelboards.

2. Installed to provide adequate grounding between all outlets and the established electrical system ground.

3. Cut square, free of burrs due to field cutting or manufacture, and bushed where necessary.

4. Installed with exterior surfaces not less than 6 in. from any surface with normal operating temperature of 200°F or higher.

5. Plugged at the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.

6. Concealed throughout except where exposure is permitted by the Owner's Representative. All exposed raceways shall be painted to match existing adjacent surface finish as directed by the Architect.

7. Installed parallel or perpendicular to floors, walls and ceilings where exposed wiring is permitted.

8. Installed with a minimum of bends and offsets. All bends shall be made without kinking or destroying the cross section contour of the raceway. Factory made bends are acceptable and should be considered for raceways larger than 2 in.

9. Installed with UL approved rain-tight and concrete-tight couplings and connectors.

10. Firmly fastened within 3 ft. of each outlet box, junction box, cabinet or fitting. Raceways shall not be attached to or supported by wooden plug anchors or supported from mechanical work such as ductwork, piping, etc.

11. Installed with a #14 AWG fish wire in all telephone, intercommunication, "Spare" or "Empty" conduit runs to facilitate future installation of conductors.

12. Installed with expansion fittings at all building expansion joints such that no undue stress is placed on any electrical raceway due to the proper functioning of expansion joints.

13. Arranged in a neat manner for access and allow for access to work installed by other trades.

14. Raceways installed in concrete slabs shall be located so as not to affect structural integrity of slab, and such that conduit shall have a minimum of 1 in. of concrete cover on all sides. Obtain approval from the Owner's Representative prior to installing conduit larger than 1 in. trade size in concrete slabs. Raceways in slabs shall be for floor box use only.

15. Raceways installed below ground floor slab shall be encased in concrete with 3 in. minimum coverage on all sides. Where possible, install conduit directly below slab with concrete envelope poured monolithic with slab. Where this is not possible, support raceways and envelop maximum 5 ft. - 0 in. on centers from underside of structural slab by means of galvanized pipe hangers. Pipe hangers shall be coated with asphalt mastic. Installation shall maintain integrity of waterproofing membrane.

16. If it is necessary to burn holes through webs of beams or girders, call such points to the attention of the Owner's Representative and receive written approval both as to location and size of hole before proceeding with work. All holes shall be burned no larger than absolutely necessary.

17. Become familiar with the general construction of the building and place sleeves, inserts, etc., as required. All penetrations through existing floors shall be core drilled and sleeved.

18. Wherever a cluster of four (4) or more raceways rise out of floor exposed, provide neatly formed 6 in. high concrete envelop, with chamfered edges, around raceways.

19. All raceways shall be supported adequately by malleable iron pipe clamps or other approved methods. In exterior or wet locations, supports shall allow not less than 1/4 in. air space between raceway and wall. Firmly fasten raceway within 3 ft. of each outlet box, junction box, cabinet or fitting. The following table lists maximum spacing between conditions, strength of supporting members, etc.

20. Furnish and install such supports at no additional cost to owner.

Conduit Trade Size	Type of Run	Horizontal Spacing in Feet	Vertical Spacing in Feet
1/2 in., 3/4 in.	Concealed	7	10
1 in., 1-1/4 in.	Concealed	8	10
1-1/2 in. and larger	Concealed	10	10
1/2 in., 3/4 in.	Exposed	5	7
1 in., 1-1/4 in.	Exposed	7	8
1-1/2 in. and larger	Exposed	10	10

21. Where raceways puncture roof, install pitch pockets as required in order that the roof warranty is maintained. Coordinate with representative of roofing material manufacturer.

22. At each flush mounted panelboard, terminal cabinet, control cabinet, etc., provide four (4) spare 3/4 in. raceways from panelboard, etc., to an area above the nearest accessible ceiling space. Make 90° turn above the ceiling, arranged for further continuation of raceway, and cap.

23. Provide a bushing at each conduit termination unless fitting at box where conduit terminates has hubs designed in such a manner to afford equal protection to conductors. Provide grounding type insulated bushings on all conduit sizes 1-1/4 in. trade size and larger, and on all feeder raceways regardless of size. Provide standard bushings for conduits 1 in. and smaller unless otherwise stated.

24. Differing Temperatures: For raceways routed between areas with differing temperatures (interior to exterior, walk in coolers/freezers, environmental chambers, etc.) install raceway as follows:

    a. Provide a thermal break, 4 in. minimum of stainless steel or Schedule 40 PVC conduit within space wall/separation.

    b. Seal raceway penetration through the wall/separation.

    c. Provide a box on each side of the space wall/separation.

    d. Provide raceway interior sealant (duct seal or suitable foam) to provide a complete air barrier after conductors are installed.

    e. Mounting of raceway and boxes on equipment shall be coordinated and approved by the equipment manufacturer.

25. Raceway installed in wet, damp or exterior walls shall have a spacer provided to maintain a space/void between the mounting surface and the raceway.

C. Underground Raceways and Ductbanks:

1. Encase all underground raceways in concrete, No. 1 (NYSDOT 0703-02) crushed stone or pea stone (NYSDOT 0702-0203). Where concrete is called for, form concrete envelope around raceways, 3 in. minimum thickness concrete at top, bottom and sides of raceways, conduits on 7-1/2 in. centers both directions with concrete between raceways. Top of concrete envelope shall be finished not less than 24 in. below finished grade, except where under building slabs. Open trench for its complete length before concrete is poured; if any obstructions are encountered, make provisions to avoid them. Support raceways minimum 3 in. above bottom of trench before pouring. Furnish and install precast concrete, plastic or fiber spacers. Stagger couplings. When concrete is specified, securely tie raceways in place to prevent floating. Pour concrete as soon as possible after placing and securing of raceways. Pull iron-shod mandrel, not more than 1/4 in. smaller than bore of raceway to remove concrete and other obstructions. Clean raceway by drawing through properly sized cylindrical brushes as many times as necessary to remove dirt. Concrete envelopes shall contain reinforcing rods wherever non-metallic raceways are used. Reinforcing shall be continuous runs of No. 4 deformed rods located in all four corners as well as top and bottom of envelope between each raceway. In locations where non-metallic raceways are used, change to heavy wall metallic conduit of same internal diameter before rising out of ground; provide metallic conduit elbows at conduit rise. Carry concrete envelope to a point 12 in. minimum above grade or floor slab at rise point if allowed by site conditions and equipment to be installed. Slope top of concrete away from raceway, chamfer edges. Where raceways pass between exterior and interior and terminate in building, switchgear, pullbox, etc. provide conduit sealing bushing (O-Z Gedney CSB or approved equal) in each raceway to fill all voids around conduit and cables. Upsize the conduit as needed for suitable sealing bushing. Cap all empty conduits watertight. Place conduit in straight lines. Seal, completely waterproof, all duct joints, then complete concrete encasement. Place direct-bury conduit tier-by-tier method, backfilling each layer to achieve proper spacing. Elbows shall have a minimum radius of 42 in. Follow proper low temperature installation procedures as recommended by PVC conduit vendor. Provide marking tape in soil above all duct banks per NEC. Repair or replace all existing utilities and facilities damage, due to ductbank installation, as part of contract.

D. Wiring Methods:

1. Conductors shall not be installed until raceway system, including all outlets, cabinets, bushings and fittings, is completed. Verify that all work of other trades which may cause conductor damage is completed. Use only U.L. approved cable lubricants when necessary. Do not use mechanical means to pull conductors No. 8 or smaller.

2. In general, conductors shall be the same size from the last protective device to the load.

3. All wiring systems shall be properly grounded and continuously polarized throughout, following the color-coding specified. Connect branch circuit wiring at panelboards, as required, in order to provide a "balanced" three-phase load on feeders.

4. Provide insulated green ground conductor in each branch circuit.

5. All feeder connections shall be made to bus and other equipment using solderless, pressure type terminal lugs.

6. For splices and taps, No. 10 AWG and smaller, use solderless "twist on" connectors having spiral steel spring and insulated with a vinyl cap and skirt.

7. For splices and taps, No. 8 and larger, use insulated solderless set screw AL/CU or hydraulically compressed sleeve fittings suitable for the intended use.

8. Use cast connections for ground conductors.

9. Provide minimum 6 in. of spare/slack of each conductor in each junction or pull box and termination.

10. Make all splices and connections in accessible boxes and cabinets only.

11. Cover uninsulated splices, joints, and free ends of conductor with rubber and friction tape of PVC electrical tape. Plastic insulating caps may serve as insulation. Heat shrink sleeves shall be acceptable for crimp type splices.

12. On termination at branch circuit outlets, leave a minimum of 8 in. free conductor for installation of devices and fixtures.

13. Feeder conductors shall be continuous from point of origin to load termination without splice. If this is not practical, contact the Owner's Representative and receive written approval for splicing prior to installation of feeder(s). Where feeder conductors pass through junction and pull boxes, bind and lace conductors of each feeder together. For parallel sets of conductors, match lengths of conductors as near equal as possible.

14. Branch circuit conductors installed in panelboards, and control conductors installed in control cabinets and panels shall be neatly bound together using "Ty-Raps" or equal.

15. Lighting fixtures, detectors, etc., in mechanical equipment, boiler and pump rooms shall be installed with exposed wiring after equipment, ductwork, piping, etc., are in place. In general, lighting shall be as located on the drawings; where conflicts exist, locate lights for best distribution.

16. Provide cable/conductor vertical support in accordance with the NEC.

17. Handholes:

    a. Provide separation of conductors of different systems per NEC requirements.

    b. Pitch all raceways toward the manhole/handhole.

    c. Mortar and brick the throats of manholes/handholes to grade level. Set cover rim to 1 in. above grass areas and flush with finished areas. Waterproof throat with elastic bituminous plastic cement coating.

E. Outlet Boxes:

1. Consider location of outlets shown on drawings as approximate only. Study architectural, process piping, mechanical, plumbing, structural, roughing-in, etc., drawings and note surrounding areas in which each outlet is to be located. Locate outlet so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts are noted between drawings, contact Owner's Representative for decision prior to installation. Comply with the NEC relative to position of outlet boxes in finished ceilings and walls.

2. Prior to installation, relocate any outlet location a distance of 5 ft. in any direction from location indicated on drawings if so directed by the Owner's Representative. Prior to completion of wall construction, adjust vertical height of any outlet from height indicated if so directed by Owner's Representative. The above modifications shall be made at no additional cost to the Owner.

3. Where outlets at different mounting heights are indicated on drawings adjacent to each other (due to lack of physical space to show symbol on drawings), install outlets on a common vertical line.

4. Where switch outlets are shown adjacent to strike side of door, locate edge of outlet box approximately 3 in. from door frame.

5. Outlet boxes in separate rooms shall not be installed "back-to-back" without the approval of the Owner's Representative.

6. Outlet boxes shall be sized to accommodate the wiring, splices and device(s) to be installed in accordance with the NEC.

7. Outlet boxes installed in plaster, gypsum board or wood paneled hollow cavity walls shall be installed flush with raised plaster covers or raised tile covers. Boxes shall be mechanically fastened and supported by two (2) adjacent structural members (studs) with cross brackets (Garvin Industries Model BMB or approved equal).

8. Outlet boxes installed in tile, brick or concrete block walls shall be installed flush and have extra-deep type raised tile covers or shall be 3-1/2 in. deep boxes with square corners and dimensions to accommodate conductors installed.

9. Surface ceiling mounted outlet boxes shall be minimum 4 in. square, 1-1/2 in. deep, galvanized sheet metal.

10. Surface wall mounted outlet boxes shall be cast type boxes.

11. Floor outlet boxes shall be installed flush with finished floor, adjust level and tile as required. Where finished floor is terrazzo, provide boxes specifically designed for installation in terrazzo. Where floors are to receive carpet or flooring material, coordinate with appropriate trade and provide insert. Rectangular covers shall be parallel and perpendicular with the building and, if used, floor tile/floor joints/pattern. Coordinate cover type with the flooring and device type.

12. Install a device cover plate over each and every outlet indicated on drawings. Do not install plates until painting, cleaning and finishing of surfaces surrounding the outlet are complete. Install single one-piece multi-gang covers over multi-gang devices.

F. Toggle Switches:

1. Switches shall be installed in accessible locations near room/space entryway(s).

2. Provide lighted handle switches in mechanical rooms, elevator pits, electric rooms, etc.

G. Junction and Pull Boxes:

1. Install junction and pull boxes in readily accessible locations. Access to boxes shall not be blocked by equipment, piping, ducts and the like. Provide all necessary junction or pull boxes required due to field conditions and size as require by the National Electrical Code.

H. Equipment Mounting Heights:

1. Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment centerline as follows:

a.	Toggle switches (up position "on")	46 in.
b.	Receptacle outlets (long dimension vertical, ground" pole farthest from floor)	18 in.
c.	Receptacle outlets above counters	8 in. above counters
d.	Receptacle outlets, above hot water or steam baseboard heaters. Do not install receptacle outlets above electric baseboard heaters	30 in.
e.	Receptacle outlets, for refrigerators	48 in.

f.	Receptacle outlets, weatherproof, above-grade	24 in.
g.	Telephone outlets	18 in.
h.	Telephone outlets, wall mounted	46 in.
i.	T.V. outlet	18 in.
j.	Fire alarm manual stations	46 in.
k.	Fire alarm combination audio/visual and standalone visual device (entire strobe lens at heights indicated)	80 in. to bottom of the notification device
l.	Standalone fire alarm audio device	90 in. (min) to 96 in. (max)
m.	Distribution panelboards, to top of backbox	72 in.
n.	Terminal cabinets, control cabinets, to top of backbox	72 in.
o.	Disconnect switches, motor starters, and enclosed circuit breakers.	48 in.

2. Where structural or other interferences prevent compliance with mounting heights listed above, consult Owner's Representative for approval to change location before installation.

I. Hangers and Supports:

1. Provide steel angles, channels and other materials necessary for the proper support and erection of motor starters, distribution panelboards, large disconnect switches, large circuit breakers, pendant mounted lighting fixtures, etc.

2. Panelboards, disconnect switches, circuit breakers, cabinets, large pull boxes, adjustable speed drives, cable support boxes and starters shall be secured to the building structure and not supported from conduits. Small panelboards, etc., as approved by Owner's Representative, may be supported on walls. Racks for support of conduits and heavy electrical equipment shall be secured to building construction by substantial structural supports.

J. Identification:

1. Provide engraved lamicoid identification nameplates on switchboards, main service disconnects, transfer switches, and on all panelboards using designation shown in panelboard schedule. Include voltage, phase, equipment served, voltage source to panel or equipment.

2. Provide engraved lamicoid identification nameplates for each circuit breaker in the main distribution panel listing the panelboard or equipment connected to each device.

3. Provide engraved lamicoid identification nameplates on all items of equipment including individual circuit breaker enclosures and disconnect switches, listing the equipment connected to the particular device provided under Specification Section 262000, including, but not limited to: starters, disconnect switches, adjustable speed drives, circuit breakers, etc. Include voltage, phase, equipment served, voltage source to panel or equipment.

4. Provide complete type written directory for each panelboard listing room number, function, etc., for each circuit breaker.

5. Identify junction and pullboxes for particular service and circuit such as power, lighting, fire alarm, telephone, interphone, public address, nurse call, etc. using stencil lettering on cover.

6. Provide signage at each electrical service room indicating "DANGER - HIGH VOLTAGE - KEEP OUT". Utilize adhesive backed, yellow background, block lettering signage at door.

7. Using adhesive backed printed tape label all receptacle and switch coverplates, power poles, etc. listing panel designation and circuit number. Tape shall be attached to inside of receptacle or switch coverplates.

K. Spare Parts:

1. Deliver to Owner and obtain receipt for spare parts including key switches, fuses, etc.

3.2 TESTS

A. Branch circuits shall be tested during installation for continuity and identification and shall pass operational tests to determine that all circuits perform the function for which they are designed. For all feeder wiring rated 600 volts or less, provide 1,000 volt "Megger" insulation test prior to energizing feeders. Use a 1,000-volt motor driven megger for all tests. Test voltage shall be applied until readings reach a constant value, and until three (3) equal readings, each one (1) minute apart, are obtained. Minimum megger reading shall be 45 megohms for feeder conductors. Document test results and submit for approval prior to energizing conductors.

END OF SECTION

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide grounding system equal to or exceeding the requirements of NEC and as indicated in the contract documents. Raceway system which includes metal conduit, wireways, pullboxes, junction boxes, busway, wire ways, cable trays, enclosures, motor frames, etc., shall be made to form a continuous, conducting permanent ground circuit of the lowest practical impedance to enhance the safe conduction of ground fault currents and to prevent objectionable differences in voltage between metal non-load current carrying parts of the electrical system.

B. Provide solid grounding of building structures and electrical and communications systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits and systems. Types of grounding systems include the following:

1. Electrical Service and Transformer Grounding
2. Building Grounding
3. Equipment Room Ground Terminal Bar
4. Electrical Equipment Grounding

1.2 QUALITY ASSURANCE

A. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions. etc., correspond to the nomenclature dictated by those manufacturers. Where "or equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

B. Electrical Components, Devices and Accessories: Listed and labeled as defined in the NEC by Nationally Recognized Testing Laboratory (NRTL) and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

1.3 REQUIREMENTS

A. Grounding conductors, bonding conductors, jumpers, grounded conductors, etc. shall be sized in accordance with the NEC.

B. Equipment and materials shall be installed in accordance with the manufacturer's recommendations.

C. Provide ground system coordinated with and in accordance with the utility company requirements.

1.4 SUBMITTALS

A. Provide submittals for the following:

1. Ground rods and connectors.

2. Ground bars.

3. Building ground resistance test results.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conductors:

1. Exposed grounding components such as bars, straps, cables, flexible jumpers, braids, shunts, etc., shall be bare copper unless otherwise indicated.

2. Grounding conductors in raceway with 600V circuiting shall be insulated to match the circuit conductors with green color.

3. Grounding conductors used with system voltage greater than 1000V shall be bare unless otherwise indicated.

4. Grounding conductor size shall be as indicated or as required by the NEC whichever is larger, stranded, soft drawn or soft annealed copper, unless otherwise indicated. Sizing shall take into account circuit voltage drop.

5. Acceptable Manufacturers:

a. Same make as for 600 volt conductors.

B. Ground Rods:

1. Provide solid copper or copper clad steel cylindrical rods, 3/4 in. minimum diameter and minimum 10 ft. long with pointed end. Provide units suitable for extension connection when ground rods longer than 10 ft. are indicated.

2. Acceptable Manufacturers:

a. Copperweld
b. Erico
c. Burndy
d. Approved equal.

C. Connectors, Clamps and Terminals:

1. Mechanical connectors and clamps shall be made of copper alloy or silicon bronze. Solderless compression terminals shall be copper, long-barrel, NEMA two bolt. Bolts and washers (Belleville) shall be of comparable material or stainless steel.

    a. Acceptable Manufacturers:

        1) Burndy
        2) Hubbell Anderson Corp.
        3) Thomas & Betts
        4) Approved equal

2. Exothermic Welds:

    a. Provide exothermic welds designed for size and type of intended cable, rods, structure, etc. Solder prohibited for connections, except for medium and high voltage cable metallic tape shields (utilize mechanical and solder).

    b. Acceptable Manufacturers:

        1) Erico "Cadweld"
        2) Burndy "ThermOweld"
        3) Approved equal

3. Pipe Clamp:

    a. Pipe clamp for bonding to pipe type electrode (water pipe, etc.) shall be a suitably sized copper alloy clamp.

    b. Acceptable Manufacturers:

        1) Burndy GAR-BU
        2) O-Z Gedney Type CG
        3) Burndy "Durium"
        4) AFL Global "Everdur"
        5) Approved equal

4. Flexible Strap:

    a. Flexible grounding straps shall be of braided high conductivity copper with two-hole connector. Strap shall have equal to or greater than ampacity of the system it is bonding to. Strap shall provide flexibility in all directions when installed properly.

    b. Acceptable Manufacturers:

        1) Burndy
        2) OZ Gedney
        3) Approved equal

5. Electrostatic Floor Bonding:

a. Listed grounding kit for bonding ESD carpet, vinyl, rubber and epoxy floor coverings and coatings to ground with the following components:

1) 1 in. wide copper grounding tape.

2) Heavy gauge stainless steel ground termination plates with double sided conductive tape and 20 in. long lead wire with a #10 terminal ring at the end.

3) Acceptable Manufacturers:

a) Ground Zero Electrostatics Inc. "Zerostat" Floor Termination and Grounding Kits.

D. Ground Bars

1. Provide ground bars where indicated. Ground bars shall be:

a. 98% conductive copper, minimum.

b. 4 in. x 1/4 in. thick minimum with length as indicated with minimum 36 in. for electric room/MDF and all other minimum of 24 in.

c. Standard NEMA bolt hole patterns with maximum quantity of lug locations. Spacing of 1-1/8 in. apart.

2. Bar shall be mounted to an accessible wall location with galvanized steel hardware and 2000V rated insulators. Mounting shall be suitable for full complement of cabling.

3. Unit shall conform to EIA/TIA standards.

4. Acceptable Manufacturers:

a. Erico
b. Newton Instrument
c. Burndy
d. Harger

PART 3 - EXECUTION

3.1 INSTALLATION

A. Grounding Conductors:

1. Provide grounding conductor(s) with all power circuits. Conductor shall be sized as indicated or as required by the NEC as a minimum and shall be terminated on the equipment, device, enclosure, etc. grounding terminal. Conductor size shall

be for the entire length unless approved by the Engineer where oversized for voltage drop.

2. Conductors above grade to ground electrodes (water piping, structural column, etc.) and to equipment (service entrance, ground bars, ground halos, etc.) shall be installed in metallic conduit with ends bonded to the conduit.

3. Grounding conductors shall be installed to have a minimum radius of 3 in.

4. Grounding conductors in a raceway system shall be terminated/bonded to each box, cabinet, enclosure, etc. through which it passes or terminates.

5. Grounding conductors routed with underground circuits shall be bonded to each ground electrode and metallic cable support system within the raceway system including pull and access locations.

6. Stranded conductors penetrating vapor barriers, foundations, slab on grade and water stop membranes shall have the interstitial spaces between strands filled with solder 4 in. beyond the membrane each side. The conductor shall be sealed to the membrane with a manufacturer approved method.

B. Raceway Systems:

1. All metal supports, cable trays, messenger cables, frames, sleeves, brackets, braces, etc. for the raceway system, panels, switches, boxes, starters controls, etc., which are not rigidly secured to and in contact with the raceway system, or which are subject to vibration and loosening, shall be bonded to the raceway system.

2. Termination of rigid conduit at all boxes, cabinets, and enclosures shall be made up tightly with a double locknut arrangement and a bushing, bushings being of the insulated type. Utilize grounding bushings as specified elsewhere in these specifications.

3. Conduit which runs to or from boxes, cabinets, or enclosures having concentric or eccentric knockouts which partially perforate the metal around the conduit and hence impair the continuity of system ground circuits shall be provided with bonding jumpers connected between a grounding type bushing/locknut on the conduit and a ground bus or stud inside the box, cabinet, or enclosure and attached thereto.

4. Conduit expansion joints and telescoping sections of metal raceways shall be provided with bonding jumpers sized in accordance with the NEC.

C. Ground Rods:

1. Ground rods shall be driven vertically the full length plus 24 in., minimum.

2. Ground rods shall be located in virgin soil or loamy compacted soil.

3. Provide one (1), minimum, ground rod inspection test well for each ground rod/electrode system or as indicated.

D. Connectors Clamps and Terminals:

1. Connectors utilized above grade in dry accessible locations shall be mechanical or exothermic type.

2. Connectors in damp locations, below grade or if not indicated shall be exothermic type.

3. Clean the area near the connecting surfaces prior to any connection to ensure effective contact. Cleaning shall be to the bare metal. Wire brush area if needed to remove rust scale paint, dirt, etc. to expose bare metal.

4. Exothermic connections shall be installed in accordance with the manufacturer's recommendations and tested with heavy blow of a five pound sledge.

E. Flexible Strap:

1. Flexible straps shall be used when bonding vibrating/moveable equipment, with expansion fittings and where recommended by the manufacturer.

2. Sufficient slack shall be provided to compensate for the anticipated vibration, movement and expansion.

F. Ground Grid:

1. Provide a ground electrode grid consisting of a minimum of three (3) 10 ft. ground rods arranged in a delta configuration with a minimum spacing of 20 ft. apart and connected together.

2. Connecting conductors shall be bare #4/0 AWG minimum, buried a minimum of 24 in. below grade.

3. Connect the ground grid to the building electric service and to the main ground bar.

G. Secondary Electrical Systems:

1. The neutral (grounded) conductor of each low voltage, single and/or polyphase system or distribution system, except special isolated double insulated systems, shall be solidly connected to ground at the transformer neutral bushing, or at the main secondary switchgear to the system ground, and shall be sized for current carrying capacity, not to be less than as required by the NEC. Ground connection shall be to the building grounding system, building steel, building water service, building concrete reinforcement and as indicated.

2. Equipment grounding conductors shall extend from the point of termination back to the ground bus of the source panelboard, switchboard, or switchgear.

H. Equipment Grounding:

1. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch circuit conductors.

I. Communications Rooms:

1. For each building communications room or closet provide one (1) wall mounted ground bar bonded to the main building ground bar or electrical service ground with insulated #2 AWG conductor.

2. Local cable trays, equipment racks, etc. shall be bonded to the ground bar by others.

J. Emergency Generators with Three Pole Transfer Switch(es):

1. Generator neutrals are not to be bonded to ground at the generator.

2. Generator neutral shall be connected to the secondary electrical distribution system neutral conductor or bus. Connection shall be made at the transfer switch neutral lug.

3. Generator frames shall be bonded to the ground system with a conductor sized in accordance with the NEC.

K. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors in conduit from building's main service equipment or grounding bus to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes using a bolted clamp connector or by bolting a lug-type connector to a pipe flange using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

L. Power Company Requirements:

1. Size #6 ground conductor from service entrance equipment to meter panel.

2. One size 3/4 in. diameter by 10 ft. ground rod and size #6 circuitry at riser pole.

3. Meet power company requirements.

M. Underground Distribution:

1. Manholes and Handholes: Provide a driven ground rod through opening in the floor/bottom with 4 in. exposed. If necessary due to the site conditions, install the ground rod prior to manhole/handhole installation and provide a #1/0AWG bare conductor from the ground rod with an exothermic connection in the manhole/handhole. Seal the opening with waterproof non-shrinking grout.

2. Bond exposed parts within manhole/handhole such as inserts, pulling rings, cable racks, ladders and cable shields to the ground rod with #2AWG bare conductor minimum. Conductors shall be neatly installed around the perimeter of the unit and support 3 ft. on center with non-corrosive support and hardware.

3.2 GROUND TERMINAL BUS INSTALLATION

A. Install ground terminal bar in rooms where shown on the drawings. Mount bar 18 in. above finished floor by anchors and bolts using 1-1/2 in. long insulated spacer between bar and wall. Use a minimum of two (2) supports 18 in. on center. Connect all grounding electrode system conductors, system enclosure ground bus, and other indicated electrode systems to the terminal bar.

B. Label grounding conductors terminated to bus for equipment, location, electrode, etc served.

3.3 TESTS

A. Test the building ground system before backfilling to ensure continuity and determine system resistance value.

B. Testing procedure shall be a fall of potential type with a moving auxiliary electrode in accordance with IEEE Standard 142 and reviewed/approved by the Engineer. Sufficient test points shall be taken for accurate resistance value.

C. Make resistance measurements in dry weather, no earlier than 48 hours after rainfall. Provide tabulated test results indicating distance between rods and resistance readings on a plotted graph.

D. Test each ground electrode system separately prior to connection to the system or main building ground bar. Test each system ground electrode system a second time after backfilling has occurred and all final connections (building steel, water service, etc.) have been made.

E. Soil type, date, time, meter manufacturer/model number, person performing the test, test witnesses and most recent rainfall shall be noted in test submittal.

END OF SECTION

SECTION 262000 - ELECTRIC DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide a complete electrical service, and distribution system as indicated on the Contract Documents and as specified herein.

1.2 QUALITY ASSURANCE

A. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc., correspond to the nomenclature dictated by those manufacturers. Where "or equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

B. Installation shall be in accordance with NFPA-70 (National Electrical Code), National Electrical Safety Code (NESC), state codes, local codes, and requirements of authority having jurisdiction.

C. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMA, UL and IEEE Standards.

1.3 SUBMITTALS

A. Submit the following product data/information:

1. Manufacturer and equipment type.

2. Standard catalog information sheet.

3. Detailed shop drawings indicating plan, elevation, end and isometric views. Top and bottom conduit areas shall be clearly shown and dimensioned on the drawings.

4. Single-line diagram.

5. Complete Bill of Materials.

6. All relevant ratings including, but not limited to, voltage, current, interrupting and withstand.

7. Overcurrent Device Information. Model number, available settings, setting ranges, capabilities, etc.

8. Submit available and final settings, programming and adjustments.

B. Submit product data and information for the following equipment, materials, products, etc.:

1. Switchboards.

2. Distribution and branch circuit panelboards.

3. Enclosed circuit breakers.

4. Disconnect switches.

1.4 WARRANTY

A. Provide full system warranty (labor, travel, equipment, etc.) in accordance with Division 1 and a minimum of one (1) year from acceptance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Distribution Switchboard:

1. Provide distribution switchboard as specified and scheduled herein and shown on the associated drawings. The switchboard shall meet Underwriter's Laboratories enclosure requirements and be furnished with an Underwriter's Laboratory label for service entrance equipment.

2. The switchboard shall be dead front with front accessibility only required. The switchboard framework shall consist of steel channels welded or bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting. The framework is to be formed, code gauge steel, rigidly welded and bolted together to support all cover plates, bussing and component devices during shipment and installation. Each switchboard section shall have as open bottom and an individual removable top plate for installation and termination of conduit. Top and bottom conduit areas are to be clearly shown and dimensioned on the shop drawings. The wireway front covers are to be hinged to permit access to the branch circuit breaker load side terminals without removing the covers. All front plates used for mounting meters, selector switches or other front mounted devices shall be hinged with all wiring installed and laced with flexibility at the hinged side. All closure plates shall be screw removable and small enough for easy handling by one man. The paint finish shall be grey ANSI Standard No., 61 enamel over a rust-inhibiting phosphate primer.

3. The switchboard bussing shall be plated copper and of sufficient cross-sectional area to continuously conduct rated full load current with a maximum average temperature rise of 50°C above an ambient temperature of 25°C. Provide grounding bus. The main horizontal or through-bus shall be rated as indicated on the drawings. The bus bars shall be rigidly braced to comply with the withstand rating of the switchboard. The main horizontal bus bars between sections shall

be located at the back of the switchboard to permit a maximum of available conduit area. The end section shall have bus bar provisions for the addition of a future section. The provisions shall include the bus bars installed and extended to the extreme side of the section and fabricated in such a fashion that the addition of a future section would require only the installation of a single splice bus connection per phase and neutral. The horizontal main bus bar supports, connections, and joints shall be bolted with carriage bolts and Belleville washers. The vertical bus shall be the same rating as the horizontal bus.

4. Each switchboard, as a complete unit, shall be given a single withstand short circuit current rating by the manufacturer. The withstand short circuit current rating shall certify that all equipment is capable of withstanding the stresses of a fault equal to the interrupting capacity rating of the smallest overcurrent protective device contained therein. Such rating shall be established by actual tests by the manufacturer on equipment constructed similarly to the subject switchboard. This test data shall be available and shall be furnished to the Architect/Engineer with the shop drawings submittal.

5. Main disconnect device shall be a molded case circuit breaker, up to 2500A, totally front accessible and front connectable. Main disconnect device shall be a molded case circuit breaker, up to 2500A, totally front accessible and front connectable. Line side circuit breaker connections are to be jaw-type plug on. Provide auxiliary tripping functions as called for. UL Listed as suitable for use as service equipment.

6. Distribution molded case circuit breakers shall be group mounted and shall be totally front accessible and front connectable. The circuit breakers shall be mounted in the switchboard to permit installation, maintenance and testing without reaching over any line side bussing. The circuit breakers shall be removable without disturbing either the line side or load side cable terminations and all line and load side connections are to be individual to each circuit breaker. No common mounting brackets or electrical bus connectors will be acceptable. Line side circuit breaker connections shall be bolt-on type. Provide an externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the circuit breaker trip mechanism to operate as well as exercise the breaker latch and operating mechanisms. Each type of circuit breaker assembly shall have undergone and passed heat tests according to UL test procedures and be UL Listed.

7. Ratings shall be as indicated in the Contract Documents. Circuit breakers within the switchboard shall be fully rated for the scheduled interrupting rating. Reducing breaker ratings on the basis of "series rating" is not acceptable.

8. Manufacturers: Subject to compliance with contract documents, the following manufacturers are acceptable:

    a. Square D "QED Power-Style" - Design Make.
    b. Eaton Corporation "Pow-R-Line".
    c. General Electric by ABB "AV-Line".
    d. Siemens "SB Series".

B. Branch Circuit Panelboards (208Y/120 volt):

1. Provide branch circuit panelboard as indicated in the "Panelboard Schedule" and as located on the drawings. Panelboards shall be equipped with quick make/quick break thermal-magnetic, molded case circuit breakers as scheduled.

2. Panelboard bussing and lugs shall be copper. Provide grounding bus in each panelboard, securely bonded to the box. Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as indicated. Such ratings shall be established by heat rise tests, conducted in accordance with UL Standard 67.

3. Provisions for additional circuit breakers shall be such that field addition of connectors or mounting hardware will not be required to add circuit breakers to the panelboard. Bus connections shall be bolt-on.

4. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the rating shown on the Panelboard Schedule or on the plans. All panelboards shall be fully rated. "Series Ratings" are NOT acceptable. Reducing breaker ratings on the basis of series rating is not acceptable.

5. The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be specified in UL Standard 50 cabinets. Wiring gutter space shall be in accordance with UL Standard 67 for panelboards. Each front shall include a door and have a flush, stainless steel, cylinder type lock with catch and spring-loaded door pull. All panelboard locks shall be keyed alike. Doors shall be mounted by completely concealed steel hinges. A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. Fronts shall be of code gauge, full-finished steel with rust inhibiting iron phosphate sealer and baked enamel finish. Minimum box width shall be 20 in. Provide door-in-door construction

6. Panelboards with main circuit breaker shall have inherent and listed coordination of the main and branch circuit breakers.

7. Ratings shall be as indicted on the Panelboard Schedule.

8. Manufacturers: Subject to compliance with Contract Documents, the following manufacturers are acceptable:

   a. 208Y/120 Volt and 240/120 Volt:

      1) Square D "NQ" - Design Make.
      2) Eaton Corporation "PRL1".
      3) General Electric by ABB "AQ".
      4) Siemens.

C. Circuit Breakers:

1. Circuit breakers below 400 amp frame shall be molded case with inverse time and instantaneous tripping functions, unless indicated otherwise in contract documents.

2. Circuit breakers 400 amp frame and above shall be 100% rated and equipped with adjustable solid state trip units with front adjustable short time, short time delay, long time, long time delay, and instantaneous trip functions as indicated.

3. Listed combination of coordinated circuit breakers shall be verified by the equipment manufacturer utilizing published data sheets. Confirm listings shall be submitted.

4. Lugs shall be mechanical, rated for 60/75° AL/Cu.

5. Branch circuit breakers shall be quick-make, quick-break, thermal-magnetic and trip indicating, and multipole breakers shall have common trip. Single pole 15 and 20 ampere circuit breakers shall be UL listed as "Switching Breakers" at 120V ac or 277 V ac and carry the SWD marking.

6. Ground-Fault circuit breakers shall be quick-make, quick-break, thermal-magnetic, 5 milliampere ground fault sensing and trip indicating, and multipole breakers shall have common trip. The ground fault circuit breakers shall not occupy any more space than a standard breaker of the same number of poles.

7. Arc Flash Energy Mitigation:

   a. Provide the following arc flash energy mitigation system for all circuit breakers 1200A and larger.

   b. Arc Energy Reduction Maintenance Switch

      1) Equipment main circuit breaker shall have a selector switch in the front of the unit enclosure for maintenance periods. The switch shall be labeled "Normal" and "Maintenance". The normal position shall utilize the standard trip settings of the breaker. The maintenance position shall utilize a quicker series of trip settings to reduce the potential arcing energy. The selector switch shall have a protective flip up cover. LED warning light on the face of the unit enclosure shall indicate when in the maintenance mode and have appropriate signage. The system shall be fully wired and tested by a factory authorized/trained technician.

8. Ratings shall be as indicated in the Contract Documents.

9. Manufacturers: Subject to compliance with contract documents, the following manufacturers are acceptable:

   a. Square D Micrologic trip unit - Design Make.

b. Eaton Corporation Optim 550 trip units for circuit breakers 400 - 1600 amp frame or RMS 610 trip units for 2000 amp frame to 6000 amp frame.
c. General Electric Spectra RMS or MicroVersa trip unit.
d. Siemens Sentron Sensitrip III trip unit.

10. Enclosed circuit breakers shall be molded case, thermal-magnetic type, ratings as noted, with overcenter, trip-free, toggle-type operating mechanism, quick make/quick break action and positive handle indication. Multiple pole breakers shall be common trip type. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pose. Provide provisions for padlocking in the "off" position. Breakers shall be calibrated for operation in an ambient temperature of 40°C and shall be suitable for mounting and operating in any position. Breakers shall have removable lugs, UL listed for copper and aluminum conductors. Breakers shall be installed in NEMA 1 general purpose, surface enclosures, unless otherwise noted.

a. Manufacturers: Subject to compliance with Contract Documents, the following manufacturers are acceptable:

1) Square D
2) Cutler Hammer
3) General Electric by ABB
4) Siemens

D. Power Meter

1. Where indicated on the drawings, provide a factory installed unit mounted power meter with the following parameters:

a. LCD or LED display.

b. Line voltage control power.

c. Voltage input with overcurrent protection and disconnecting means.

d. True RMS voltage and current measurement.

e. Metered parameters: Phase current, line voltage, phase voltage, frequency, power factor per phase and three phase total, real power per phase and total, reactive power per phase and total, apparent power per phase and total, total real energy, total reactive energy, total apparent energy, user configured sliding window for real, reactive and apparent power peak demand. Sampling rate shall be 512 sample points per cycle minimum. Waveform capture with adjustable triggers.

f. Accuracy: Energy, and demand power: 0.2% in accordance with ANSI C12.20Instrument current transformers shall be factory wired to shorting blocks to prevent open-circuiting the current transformers under energized conditions. The meter shall also be user programmable for current to any CT ratio.

g. Capable of metering up to 480 volts without external potential transformers. The meter shall also be user programmable for voltage range to any PT ratio.

h. Communications: Modbus RTU, TC/IP, etc.

i. Acceptable Manufacturers:

1) Equipment (Unit Manufacturer)
2) Square D
3) Eaton
4) Shark

E. Disconnect Switches:

1. Shall be heavy-duty type three-pole, with "Quick Make/Quick Break" operating handle mechanically interlocked with the cover, horsepower and voltage rated to match equipment served. Where indicated switches shall be provided with dual-element, time delay, rejection type fuses. Switches shall be installed in NEMA 1, 12 for indoor use, NEMA 4X for outdoor use. Provide provisions for padlocking in the "off" position. Provide neutral bar in single phase or three phase, four wire circuits, and ground bar in all switches. Provide auxiliary contacts where called for.

2. All disconnects connected downstream of ASD's shall have a normally open and normally closed auxiliary contacts which shall be wired to the ASD to indicate disconnect is open.

3. Manufacturers: Subject to compliance with Contract Documents, the following manufacturers are acceptable:

a. Square-D - Design Make.
b. Cutler Hammer.
c. General Electric.
d. Siemens.

F. Elevator Control Switch:

1. Provide elevator control switch in a single NEMA 12 enclosure with required relays, control transformer and other options listed below.

2. The elevator control switch shall be constructed, listed and certified to the standards listed below:

a. Enclosure Switches; UL 98.

3. All work shall be performed in accordance with the latest edition of the following:

a. NFPA 70 - Section 620-51 (a-c), 620-62, 620-91 (c).

b. ANSI/ASME A17.1 - Section 102.2 (c) (3).

c. BOCA 3006.2.3.

d. NFPA 72 - Section 3-9.4.4.

4. The elevator control switch shall have an ampere rating as indicated on drawings and shall include a horsepower rated fusible switch with shunt trip capabilities.

5. Provide with current limiting fuses at 200,000 amp RMS symmetrical of size(s) coordinated by the elevator manufacture for protection of their equipment.

6. The elevator control switch shall include a 100VA control power transformer with primary and secondary fuses 120 volt secondary.

7. The elevator control switch shall include an isolation relay external dry contact indication (3PDT, 10 amp, 120 volt).

8. A normally open dry contact from the fire alarm system shall energize an isolation relay and activate the shunt trip solenoid.

9. The switch shall include a 120 volt key test switch and a 1-NO/1-NC mechanically interlocked auxiliary contacts rated 5 amp, 120 volt AC.

10. The switch shall also include the following:

a. "On" pilot light (green).

b. Isolated full capacity neutral.

c. Fire alarm monitor relay.

d. Main switch auxiliary contacts (1-NO/1-NC).

11. Design Make: Eaton Corp.

12. Approved Manufacturers: Littlefuse, VTI, Siemens.

G. Fuses:

1. All fuses rated 600 volts and below shall be rejection type dual-element, time-delay type. Provide two (2) complete sets of fuses for all fusible devices. Deliver spare fuses to the Owner and obtain receipt.

2. Manufacturers: Subject to compliance with Contract Documents, the following manufacturers are acceptable:

a. Fuses 600 Amperes and Below: Bussman Type FRS-R (600 volts), Bussman Type FRN-R (300 volts) or equivalent.

b. Fuses Rated Above 600 Amperes: Bussman Type KRP-C or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment shall be grounded per the NEC.

B. Electrical distribution equipment shall have lugs/terminations suitable for the indicated conductor size. Where conductors have been oversized for voltage drop and where approved by the Engineer it shall be allowed to reduce the conductor size using hydraulically crimpled splice in a box next to the distribution equipment to allow for standard lug termination.

C. Distribution switchboards shall be mounted on 4 in. high concrete pads which shall extend 3 in. on all sides. Securely bolt the unit to the pads for proper horizontal and vertical alignment.

D. Provide pad lockable branch circuit breaker device to hold circuit breaker in the closed position, but not prevent overcurrent protection, for all branch circuits serving fire alarm controls panels, emergency lighting and life safety branch circuits.

E. Identification:

1. Identify all items of equipment as described in Section 260501-3.1, Identification. Identification shall be provided for switchboards, panelboards, transformers, ASD's, motor starters, disconnect switches, enclosed circuit breakers, switchboard main/distribution breakers, MCC's automatic transfer switches, UPS's, generators, surge suppression devices, control panels, switchgear, etc.

2. Switchboards, panelboards, etc. shall have a label indicating name/tag ID, feeder source, conductor color convention and for service entrance locations the available short circuit current.

3.2 ELECTRICAL LOAD TEST

A. Conduct a load test prior to request for final payment and comply with the following:

1. Energize maximum normal light and power load for a period of two hours when scheduled.

2. Record voltage at service and at each panel.

3. Measure current in each phase of all feeders.

4. Adjust transformer taps as directed by engineer after review of report.

5. Provide and install all necessary metering equipment.

6. Owner's Representative or Site Representative shall witness the test.

7. Before final acceptance specified test shall be completed to the satisfaction of the Owner's Representative who shall be sole judge of the acceptability of such tests and who may direct the performance of such additional tests as deemed necessary in order to determine the acceptability of the systems, equipment, material and workmanship. Additional tests required by the Owner's Representative shall be provided at no additional cost. Protective equipment shall be actuated in a manner that clearly demonstrated their workability and operation.

3.3 CLEANING

A. At the completion of the project, while equipment is de-energized, it shall be thoroughly cleaned to a shipped condition using methods in accordance with the manufacturer's recommendations. Utilize vacuum for cleaning and not compressed gas.

3.4 SPARE PARTS

A. Deliver loose equipment to the Owner and obtain receipt for fuses, keys to panelboards, etc.

3.5 DISCONNECT DEVICES

A. All disconnect devices downstream of ASD's: Provide wiring, conduit and connections between ASD and disconnect auxiliary switch to ASD.

END OF SECTION

SECTION 262713 - ELECTRIC SERVICE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labor, materials, equipment and services for the complete installation of an electric service and related Work required in these Contract Documents. The Utility Company is National Grid.

1.2 UTILITY COMPANY

A. Include all utility company fees and charges for service as part of contract.

1.3 QUALITY ASSURANCE

A. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc., correspond to the nomenclature dictated by those manufacturers. All equipment shall be tested at the factory. Standard factory inspection and operational tests will be acceptable.

B. Installation shall be accordance with utility requirements NFPA 70 (National Electrical Code), National Electrical Safety Code (NESC), state codes, local codes, and requirements of authority having jurisdiction.

C. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMA and IEEE Standards.

1.4 SUBMITTALS

A. All items of equipment and accessories including the following:

1. Underground ductbank materials.

2. Billing Instrument transformer enclosure.

3. Utility Company mast anchoring detail.

4. Equipment pad/vault.

B. Send three copies of submittals to the Utility Company for review before sending submittals to Engineers. Include one (1) Utility Company approved copy with submittal drawings for review.

1.5 SERVICE CHARACTERISTICS

A. Secondary Service:

1. Low Voltage: 208/120 grounded, wye, three phase, four wire, 60 Hz.

2. Source:

a. Utility Company pad mount transformer, for underground service.

1.6 UTILIZATION VOLTAGES

A. Building power system shall be a nominal 208/120 volt, three phase, four wire, solidly grounded, 60 Hz system.

1.7 UTILITY COMPANY COORDINATION

A. Coordinate entire electric service with Utility Company.

B. Do not interrupt electric system until approved in writing, coordinated so outages occur at Project Site convenience.

C. Coordinate switching requirements with utility company, as approved in writing by the Owner.

1.8 DEMAND CONTROL SYSTEM INTERFACE

A. Coordinate with utility company, and provide all requirements for interfacing demand pulse signaling equipment on utility company kWH/demand metering instrument, and pay all fees and charges.

PART 2 - PRODUCTS

2.1 UNDERGROUND SERVICE DUCTBANK

A. Refer to Section 260501.

2.2 TRANSFORMER PAD

A. Refer to Drawings.

2.3 UTILITY COMPANY METERING ACCOMMODATION

A. Verify all requirements with Utility Company before proceeding.

B. Utility Company shall furnish all billing instrument CT and PT transformers.

C. Provide code gauge metal cabinet, as approved by Utility Company, to house billing instrument transformers.

D. Provide Meter Backboard:

1. Use 3/4 in. x 5 ply marine grade plywood.

2. Paint front and back of plywood with two (2) coats of exterior gray paint.

3. Size as required by utility company.

PART 3 - EXECUTION

3.1 UTILITY COMPANY METERING ACCOMMODATION

A. Verify all installation requirements with utility company before proceeding.

B. Install meter backboard. Space board from wall when located on outside wall. Provide required clearances.

C. Mount CT cabinet where called for and as directed by the Utility Company.

D. Install instrument current and potential transformers in cabinet.

E. Provide 1-1/2 in. rigid galvanized steel conduit from the instrument transformer location to the meter backboard.

F. Install all test devices furnished by the Utility Company.

G. Utility Company shall provide all Utility Company metering instruments. Install all meter sockets as required.

H. Provide wiring from meter instrument to metering transformers as directed by Utility Company.

I. Provide grounding, connections and miscellaneous materials required.

3.2 INSTALLATION AT RISER POLE

A. Terminate at existing riser pole.

B. Stub conduit at position directed by Utility Company.

C. Provide hot dipped galvanized steel rigid conduit at riser.

D. Stub active conduit to height directed by Utility Company and cap.

E. Stub spare conduit to height directed by Utility Company and cap waterproof with threaded cap.

F. Strap conduit to pole every 4 ft.

G. Ground as directed by Utility Company.

END OF SECTION

SECTION 263213 - POWER GENERATION - GENERATOR, AUTOMATIC TRANSFER SWITCH AND ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services for the complete installation of generator, automatic transfer switch and related work required in these Contract Documents.

1.2 QUALITY ASSURANCE

A. All methods of construction, details of workmanship that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by those manufacturers. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

B. Installation shall be accordance with NFPA 70 (National Electrical Code), NFPA 110 (Standard for Emergency and Standby Power Systems), National Electrical Safety Code (NESC), state codes, local codes, and requirements of authority having jurisdiction.

C. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMA, UL and IEEE Standards. If skintight enclosure is used, the equipment shall conform to UL 2200.

D. System emissions shall meet or exceed the EPA and Code of Federal Regulations 40CFR.

1.3 SUBMITTALS

A. Submit shop drawings only for manufacturers named. Submission of other manufacturers will be rejected unless the terms of equivalents and substitutions stated in the General Provisions are followed.

B. Submit shop drawings on equipment and accessories to include the following:

1. Engine-generator set, including engine, radiator, alternator, circuit protection, fuel consumption, exhaust flow/temperature, noise (dBA), performance ratings (kW, starting kVA, pf, voltage, etc.), thermal ratings, heat generation.

2. Engine controls, including starting controls, governor, etc.

3. Generator instrumentation, voltage regulator, insulation class, etc.

4. Catalog cuts, bill of materials, descriptive data, spare parts list for specified equipment.

5. Mounting arrangement, floor plans, elevations, overall dimensions including accessories, foundation, bedrail, and/or bolts, power and control conduit entrance space.

6. Weatherproof enclosure: dimensions, elevation, plan, attenuation, cooling, accessories, etc.

7. Batteries, mounting rack, accessories.

8. Gas regulator.

9. Automatic transfer switch and accessories.

10. Remote annunciator panel.

11. Software and details of remote monitoring system.

12. Wiring diagrams of all equipment, external and internal connections and interconnections.

13. Emergency shutdown switch.

14. Factory tests and field supervision reports as called for. Include information described in 1.4 below pertaining to field supervision.

C. Composite Instruction Books shall include as a minimum the following:

1. Instructions covering overall equipment.

2. Instructions covering all major and serviceable components, and accessories.

3. Recommended spare parts with current prices.

4. Complete renewal parts information.

5. Quantities of oil/coolant/etc.

6. Instructions, both individually and collectively, shall adequately describe receipt, handling, care, inspection, installation, operation, and maintenance of equipment.

7. Instruction books shall be used for equipment installation, and submitted prior to project closeout.

8. Factory trained maintenance provider contact information.

9. System error code (alarms, faults, etc.) list with descriptions.

1.4 STANDARDS AND TESTS

A. Equipment covered by these specifications shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of all applicable published ANSI,

NEMA, and IEEE Standards, the requirements of NEC, NFPA 37, NFPA 110, UL 1008 and UL 2200 Standards. State and local requirements.

B. Furnish submittals of field test reports covering field tests and inspections performed and conducted by manufacturer's representative.

1.5 FIELD SUPERVISION

A. Submittal shall state that adequate local within 75 mile radius of project locations field supervision and service, by competent qualified representative of the manufacturer, who is regularly engaged in working on this type of equipment, will be available at any time.

B. Submittal shall state address of nearest vendor's place of business, telephone number and name of person to contact for field service.

C. Provide field supervision/service at no additional cost to cover inspection, test, and start-up of this equipment.

D. Submittal shall state the amount of field supervision/service recommended by vendor to cover critical points of installation, inspection, test, and start-up.

E. Provide proposal for a yearly maintenance agreement for time beyond the warranty period.

F. The above data shall be included with submittals.

1.6 RIGGING

A. Provide rigging to unload, move, transport, set in place, erect, etc.

1.7 WARRANTY

A. Provide a warranty for the specified equipment to be free from defects in materials and workmanship, whether functional or nonfunctional, replace or repair without cost, defects which, with normal usage, appear within one (1) year of project closeout.

B. During the warranty period provide preventative maintenance as recommended by the manufacturer for the system every six (6) months.

1.8 TRAINING

A. Provide verbal and written training to facility appointed personnel in the proper and safe manner of operating equipment.

B. Training shall be at a time convenient for the Owner, not during system start up/testing and be a minimum of 4 hours or as needed for the Owner personnel to understand the system operation and maintenance.

1.9 DESCRIPTION OF SYSTEM OPERATION

A. Provide Engine-Generator System to meet the following functions:

1. Arrange system for automatic starting upon failure of normal source voltage.

2. Provide programmable one-second time delay, field adjustable from 0 to 9999 seconds. Delay time between normal source failure and engine**(s)** starting.

3. Initiate engine**(s)** starting cycle from transfer switch auxiliary dry contact.

4. Transfer loads from normal source power to emergency source when engine-generator reaches 90% of its rated voltage.

5. Retransfer emergency loads from emergency generator to normal source ten (10) minutes after normal source has reached 90% or more of normal voltage. Control shall be field programmable from 0 to 9999 seconds.

6. Retransfer emergency loads from emergency generator to normal source instantaneously when normal source has reached 90% or more of normal voltage, if emergency generator has failed while supplying load.

7. Run engine for a period of ten (10) minutes after retransfer of emergency loads to normal source. Engine-generator(s) will then shut down, automatically resetting and leaving all controls ready for the next emergency start condition. Period shall be programmable from 0 to 9999 seconds.

8. Use integral automatic transfer switch time clock to automatically exercise engine once every four weeks for 1 hours. Time clock contacts shall simulate loss of normal voltage; start engine, and shut engine down after fifteen minutes of operation. The load shall not transfer to the emergency source during the exercise time. Provide a selector switch to permit cycling engine-generator under load or no-load conditions.

9. Provide interconnection with Facility building management system. Communication shall be through the Facility network system and shall communicate generator status including, faults.

10. Shall shutdown via remove emergency shutdown button.

PART 2 - PRODUCTS

2.1 ENGINE-GENERATOR SET

A. General: The system shall meet the following parameters.

1. 208Y/120 volts, 12 lead, three phase, four wire, connected, 60 Hz.

2. 300 kW stand-by rating at 0.8 power factor.

3. Minimum motor starting kVA rating shall be 730, based on 30% instantaneous voltage dip.

4. Suitable for ambient conditions:

   a. Ambient Temperature: -25C to 40°C.

   b. Altitude: 1000ft above sea level.

5. Maximum of 247.5 in. L x 71 in. W x 80 in. H (with silencer).

6. 7-11 in. WC of utility natural gas pressure.

7. Maximum allowable combustion exhaust of 0.5 in. WC.

8. Combustion exhaust temperature shall not exceed 1,277°F and 2,113 CFM.

9. System fuel consumption shall not exceed 4,140 CFH GPH.

B. Engine - Gaseous Fuel:

1. Single fuel carburetion for natural gas.

2. Minimum six cylinder, four stroke cycle, 1800 rpm.

3. Stand-by rating shall be adequate to provide maximum kW output of generator under full load and motor starting kVA requirements. The engine generator set shall be capable of picking up 100% of nameplate kW, after adjusting for site conditions (altitude, temperature), in one step with the engine generator set at operating temperature, in accordance with NFPA-110. A resistive load bank (1.0 pf) shall be acceptable for meeting the load requirements.

4. Carburetor, secondary gas regulator, electric solenoid shutoff valve, strainer (fuel filter), gas shutoff cock.

5. Provide primary gas regulator if required by characteristics of local utility gas supply. Gas pressure available at engine regulator is 7-11 in. WC.

6. Full pressure lubrication system with positive displacement, mechanical, full pressure gear type oil pump, full flow oil filters with replaceable filter element, equipped with spring-loaded bypass valve as an insurance against stoppage of lubricating oil in the event filter becomes clogged; water-cooled oil cooler and thermostat.

7. One or more oil or dry type air cleaners of sufficient capacity to protect engine working parts from dust and dirt.

8. Water cooled with skid mounted, closed loop type radiator, belt-driven pusher fan, centrifugal water circulating pump, thermostat temperature control, liquid-cooled exhaust manifolds suitable for unit full load operation and 50°C ambient

condition. Provide radiator with duct connection flange. Rotating parts shall be protected against accidental contact. The cooling system shall be rated for full rated load operation in 50°C ambient conditions. Low coolant level sensor alarm and shutdown.

9. Provide 50/50 solution of propylene glycol for engine closed loop cooling system.

10. Provide thermostatically controlled water jacket heater suitable for the intended location and wiring, rated for 120 volt, single phase operation. Unit shall be sized to maintain unit temperature for optimum starting conditions. Provide circuit for this from a normal power source.

11. Engine speed isochronous (0% droop) electronic governing system capable of parallel operation with load sharing controls.

12. Battery starting system per manufacturer's recommendations. Voltage shall be suitable for the needed starting capability, batteries and voltage drop.

13. Engine mounted battery charging alternator (belt driven), 35 ampere minimum, and solid-state voltage regulator. Higher charging current unit shall be provided as recommended by the manufacturer.

14. An electric starter capable of three complete cranking cycles without overheating, before overcrank shutdown. Shall comply with NFPA 110.

15. The engine-generator set shall be mounted with vibration isolators on a heavy duty steel rail base to maintain proper alignment between components. The engine-generator set shall incorporate a battery tray with battery hold down clamps within the base rails. Provisions for stub up of electrical and fuel connections shall be within the footprint of the generator set base rails.

C. Generator/Alternator:

1. Synchronous, four pole, compatible with unit rpm, revolving field, fireproof construction. Brushless, permanent magnet exciter with solid state voltage regulator.

2. Insulation rating of alternator shall, at a minimum, meet requirements of NEMA Class H construction to comply with NEMA standard MG1-22.40 and 16.40. Temperature rise of rotor and stator shall be limited to Class F (155°C or 105°C maximum temperature rise of winding, measured by resistance method, at 40°C ambient) for standby rating.

3. Insulation rating of alternator shall, at a minimum, meet requirements of NEMA Class H 180°C construction to comply with NEMA standard MG1. Temperature rise of rotor and stator shall be limited to 150°C maximum temperature rise of winding, measured by resistance method, at 40°C ambient) for standby rating.

4. Voltage regulation within 0.5% plus or minus of rated voltage for any constant load from no load to full load.

5. Frequency regulation shall be isosynchronous from steady state no load to steady state rated load. Speed variations for constant loads from no load to rated load shall not exceed ±0.25% of rated speed, with constant ambient and operating temperature.

6. Provide plus or minus 5% voltage adjustment.

7. Total harmonic distortion (THD) shall not exceed 5% of rated voltage and no single harmonic shall exceed 3% of rated voltage.

8. Telephone influence Factor; TIF shall be less than 50 per NEMA MG1-22-43.

9. Terminal voltage re-established to within 2% of rated voltage within two seconds following any sudden change in load between no load and full load or between full load and no load.

10. Sealed, permanently lubricated ball bearings.

11. Direct-driven generator cooling blower.

12. Provide fixed field connections to AC output leads in extra-large terminal box with removable cover.

13. Provide adequate wiring space for conduits. Power cables shall exit the bottom of the generator.

14. Exciter shall be brushless, permanent magnet type.

D. Generator Auxiliary Equipment:

1. Provide generator output circuit breaker, three pole, common trip, thermal magnetic type, to completely protect the generator from overloads; frame size and trip rating as called for. Provide solid state trip unit and 100% rating for circuit breakers 250A and above with long time, short time and instantaneous adjustable settings.

2. Provide and install a clearly identified NEMA 12 surface mounted remote shutdown switch per generator manufacturer's recommendation similar to ASCO 12404. Provide wiring in conduit per manufacturer's recommendation.

3. Outdoor weather-protective housing with exhaust muffler installed and located within the housing. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color. All hardware (hinges, screws, bolts, door operator, etc.) to be stainless steel. Input and output air dampers with controlled damper motorized actuators shall be spring open and held closed when not in use. Unit sound attenuation shall limit

the noise level to 78 dB at 23 ft. Provide concrete pad as detail on the drawings. Generator unit shall be UL 2200 labeled with enclosure installed.

4. Battery Heater: Provide pad type battery heater suitable for intended location. Provide circuit for this from a normal power source.

E. Acceptable Manufactures:

1. Cummins/Onan
2. Generac
3. Caterpillar (Design Make)
4. MTU/Detroit Diesel
5. Kohler

2.2 MICROPROCESSOR ENGINE-GENERATOR SET CONTROL

A. The control shall have automatic remote start capability. Starting cycle shall be initiated by auxiliary contact(s) in automatic transfer switch. A panel mounted switch shall stop the engine in the STOP position, start and run the engine in the RUN position, and allow the engine to start and run by closing a remote contact, and stop by opening the remote contact when in the REMOTE or AUTOMATIC position.

B. The control shall include a cycle cranking function. The cranking cycle, nonadjustable, shall consist of an automatic crank period of approximately 15 seconds duration followed by a rest period or approximately 15 seconds duration. Cranking shall cease upon engine starting and running. Two (2) means of cranking termination shall be provided, one as a backup to the other. Failure to start after three cranking cycles (75 seconds) shall shutdown and lockout the engine, and visually indicate an overcrank shutdown on the panel.

C. The control shall shut down and lock out the engine upon: failing to start after the specified time (over crank), overspeed, low lubricating oil pressure, high engine temperature, or operation of a remote manual stop station. Provide audible alarm and visual indication of the particular contact that operated, and reset pushbutton. Provide common fault contacts, wired to terminal board for remote alarm indication.

D. The control shall provide a twelve light (LED) minimum engine monitor on the control panel; one red light for each of the five shut downs (except the remote manual stop), and one yellow light each for the high engine temperature and low engine oil pressure prealarms, and one green run light. The control panel monitor shall include; a flashing red light to indicate the generator set is not in automatic start mode, a yellow light to indicate low coolant temperature, a yellow light to indicate low fuel, a red light to indicated battery charger failure, and one red light for auxiliary use (for a total of twelve). A panel mounted switch shall reset the engine monitor and test the lamps. The engine-generator set starting battery(ies) shall power the monitor. Operation of shut down circuits shall be independent of indication and prealarm circuits. Individual relay signals shall be provided for each indication for external circuit connections (not to exceed 1/2 amp draw) to a remote annunciator. A common contact for external connection to an audible alarm shall be provided.

E. Provide a low coolant level shutdown, which shall be indicated as a high engine temperature fault.

F. The NEMA 1 enclosed control panel shall be mounted on the generator set with vibration isolators. The control shall include surge suppression for protection of solid state components. A front control panel illumination lamp with On/Off switch shall be provided. Control panel mounted indicated meters and devices shall include: Engine Oil Pressure, Oil Temperature, Coolant Temperature, low coolant alarm/shutdown, DC Voltmeter, and Running Time Meter (hours); Voltage adjusting rheostat, locking screwdriver type, to adjust voltage ±5% from rated value; Analog AC voltmeter, dual range, 90 degree scale, 2% accuracy; Analog AC Ammeter, dual range, 90 degree scale, 2% accuracy; Analog Frequency meter, 45-65 Hz, 90 degree scale, ±0.6 Hz accuracy; kW; kVA; power factor; Seven position phase selector switch with OFF position to allow meter display of current and voltage in each generator phase. Provide shorting-type terminal boards for all current transformer secondary windings. Liquid crystal display (LCD) shall be utilized for display of metered items and alarm/trouble indication.

G. Control panel shall have an interior RJ45 outlet for Ethernet connection and provide all information indicated herein for remote monitoring utilizing the manufacturer software.

H. Provide remote annunciator at first floor Aide Station for engine-generator alarm function. Alarm functions for generator are as follows:

1. Visual signals for: Battery charger AC supply failure, battery charger DC output failure, engine-generator running.

2. Visual and audible signals for: Overspeed, low lube oil pressure, high and low water temperature, overcranking (failure to start), overload.

3. Provide all of the indications and audible alarms called for above. Provide alarm silence and lamp test switches.

2.3 BATTERIES

A. Provide batteries as follows:

1. Lead acid type, VDC, quantity and connections as recommended by the generator set manufacturer.

2. Provide corrosion-resistant battery mounting rack, battery interconnecting cables and terminals, etc.

3. Provide battery heating pad suitable for the intended location, 120 VAC and power connection to maintain 10 second starting time.

2.4 AUTOMATIC TRANSFER SWITCH (ATS)

A. Description:

1. The automatic transfer switch shall consist of a power transfer switch and a microprocessor based control module, interconnected to provide complete automatic operation. Double throw, mechanically and electrically interlocked. All main contacts shall be of silver composition. The operating transfer time shall be a maximum of 1/2 of a second. Transfer switch shall be capable of manual transfer in order to meet the requirements of UL 1008 and UL listing requirements as described UL's "Electrical Construction Materials."

2. Operated by momentary energization of a single coil with mechanical latching in both normal and emergency positions.

3. Operating voltage for transfer obtained from source to which load is to be transferred.

4. Three phase, four wire, three pole, solid neutral 120 volt normal and emergency power source contacts.

5. Ampere rating as called for, rated for continuous duty.

6. Provide magnetic blowout coils and arc barriers on each pole.

7. Provide voltage supervisory relays on each phase of both normal and emergency sources, such that transfer and engine start is affected should any one phase of the three phase supply be below 80% of normal voltage.

8. Three-cycle closing and withstand rating minimum 35,000A rms symmetrical amperes without the use of current limiting fuses.

9. Manufacturer's standard mechanical type lugs suitable for aluminum or copper conductors. Provide lugs for each power cable, phase and neutral. Cable size and conductor type as called for. Terminals front connected.

10. Provide dual transfer switch operator with adjustable time delay 0-9999 seconds set at 3 seconds for a neutral position to allow motor loads residual voltage to decay between the time that the closed source is opened and the open source closed.

11. Provide pilot lights (LED's) as follows:

    a. Green, indicating normal switch position.

    b. Red, indicating emergency switch position.

    c. Fuse for each light.

12. Provide the following accessory features:

    a. Adjustable time delay before engine starting, field programmable from 0-9999 seconds. Factory set at 1s.

b. Adjustable time delay on transfer to emergency, field programmable from 0-9999 seconds. Factory set at 3s.

c. Adjustable time delay on retransfer to normal field programmable from 0-9999 seconds, factory set at 300 seconds. Final delay to be coordinated with elevator installation.

d. After retransfer to normal, the engine generator set shall be allowed to run, unloaded, for an additional 0-9999 seconds, factory set to 300 seconds.

e. Test switch, engine start and transfer.

f. Pushbutton to bypass time delay on retransfer back to "normal" position.

g. Engine start contact.

h. Time clock exerciser with transfer. Retransfer shall be automatic at end of exercise period. Provide a bypass switch for manual exercise and a selector switch to permit cycling engine-generator under load or no-load conditions.

i. Auxiliary contacts for normal, emergency and neutral position, two form C for each position. No common wires for auxiliary contacts. Bring wires to terminal block, suitably labeled.

j. Accommodate control input for load shedding. Signal shall drive ATS to neutral position.

k. A contact which closes when normal source fails for initiating engine starting, rated min, 10A @ 32 VDC.

l. A contact which closes when unit is on emergency power and normal power returns and is suitable for use. Contact shall be wired to elevator controller.

m. Provide ground studs to enclosure for mechanical lugs for size #4/0 copper cables.

n. Provide any other accessories as may be required to achieve operation as described in Article 1.9.

o. Provide box of spare fuses and LED's for pilot lights.

p. Provide NEMA 12 sheet metal enclosure for all mounting, front door hinged.

q. All time delay relays shall be field programmable and shall show the actual setting time in minutes or seconds.

B. Design Equipment: Russelectric RMT (single operator) or RMTD (dual operator) series.

C. Make: ASCO, or acceptable generator set manufacturer's ATS utilizing specified make's transfer switch.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. General Requirements:

1. Completely coordinate installation, assure that elements of the system are compatible, operational and correct.

2. Provide rigging to unload, move, and set/bolt in place engine-generator and ATS. Provide concrete pad as detailed on the drawings.

3. Provide miscellaneous bolts, washers, nuts, clips, lockwashers, small hardware, etc., of durium or equal rust resistant material, to make installation complete.

4. Refer to "Grounding" section of specifications.

5. Install equipment plumb, level, and true.

6. Leave maximum space available in front, alongside, etc., all items of equipment, to allow easy access and servicing of serviceable components. Meet NEC requirements.

3.2 WIRING

A. Install power and control wiring between engine-generator set, transfer switch, battery charger, louvers, dampers, controls, coolers, batteries, day tank and all other various and related equipment. Provide all necessary wiring and interface equipment to interconnect generator system with the Facility building management system.

B. Comply with Manufacturer's Instruction Books.

C. Maintain phasing standards as called for and rest of the system.

D. Color code and identify control and power wires and cables as called for.

E. Provide copper, 600 volt insulation minimum, control wiring; do not splice.

F. Provide "crimp-on" type terminal for control wire terminations, as called for.

G. Provide liquid-tight jacketed flexible conduit for all connections to engine, generator, and to day tank. All connections shall account for the anticipated vibration.

H. Provide green ground conductor in each conduit run.

3.3 ENGINE - GENERATOR INSTALLATION

A. Install where indicated. Refer to drawings for installation detains, pad details, etc.

B. Provide necessary anchor bolts at proper locations, place by templates if required, for proper setting of engine-generator.

C. Manufacturer's Representative shall provide lube oil and anti-freeze for initial start-up. Electrical Contractor shall provide all fuel for start-up and testing and leave tank at the full level upon completion.

D. Entire system shall be complete and operational and shall be test operated, including simulated loss of normal power, all control devices shall be operated to test their function.

E. Determine exact requirements, verify locations, and comply with applicable regulations in installing equipment.

F. Provide the services of the manufacturer's representative to check out the system and instruct the Owner in the operation of the system. Furnish written statement to the Owner's Representative that the checkout and instruction service has been provided. Include statement that system operates properly, as called for. Submit statement as a submittal for review.

3.4 FUEL PIPING

A. Division 22 shall provide natural gas piping to engine-generator and make final connection.

B. Provide fuel filter, fuel solenoid valve, secondary regulator, gas shutoff cock, flexible fuel piping and fuel piping diagram.

C. Coordinate fuel piping size with these items.

3.5 IDENTIFICATION

A. For installations that have a single grounding location (connected to the main service entrance) provide signage indicating the following: "WARNING - SHOCK HAZARD EXISTS IF GROUNDING ELECTRODE OR BONDING JUMPER IN THE EQUIPMENT IS REMOVED WHILE ALTERNATE SOURCE(S) IS ENERGIZED."

3.6 ELECTRICAL LOAD TEST

A. Conduct a resistive load bank test to the full capacity of the generator for four hours after completion of installation, but before connecting to the building system. Record system voltage, current, kW, pf, oil pressure and temperature every 15 minutes with the manufacturer recommended values in the test report. Upon successful completion of load bank test, complete connections to building system and perform an operational test as outlined in "B" below.

B. Conduct a full operational test of complete system prior to request for final payment and comply with the following:

1. Start the generator by simulating a loss of utility power at each transfer switch.

2. Energize maximum emergency light and power load for a period of one hour when schedule.

3. Record voltage at generator and at each panel, using the same digital meter at each location.

4. Measure current in each phase of all feeders, using the same digital meter at each location.

5. Record the time from power loss to engine start and power transfer for each transfer unit.

6. Reconnect circuits in an effort to provide balanced (within 10%) load on all feeders.

7. Provide and install all necessary metering equipment.

8. Owner's Representative shall witness the test.

9. Provide complete test report with attendees, time, date, initial parameters, test results and sign off.

10. Before final acceptance, specified tests shall be completed to the satisfaction of the Owner's Representative who shall be sole judge of the acceptability of such test and who may direct the performance of such additional tests as deemed necessary in order to determine the acceptability of the systems, equipment, material and workmanship. Additional tests required by the Owner's Representative shall be provided at no additional cost. Notify Engineer when load bank test is scheduled two (2) weeks prior to actual test.

3.7 EQUIPMENT PROTECTION

A. Provide repair or replacement for all damage and defacement, whether functional or nonfunctional, to all equipment from the time it is unloaded, during installation, and during period of beneficial use, and until installation is accepted.

END OF SECTION

SECTION 265000 - LIGHTING

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 DESCRIPTION

A. Provide interior and exterior lighting systems, including luminaires, hangers, supports, fittings, lamps, wiring, connections and controls, as indicated in the Contract Documents for complete and operational systems. Luminaires, in general, have been specified for the particular type of ceiling in which they are to be installed. Verify the ceiling construction details and provide luminaires suitable for the respective ceiling types and room finish schedule.

1.3 REFERENCES

A. The following standards, criteria, codes, etc. shall be followed in the manufacture and installation of the lighting systems.

1. NFPA
2. NEC
3. IESNA
4. NEMA
5. ANSI
6. UL

1.4 ENERGY CONSERVATION WORK

A. Work installed as part of this Contract will be eligible for energy rebates/incentives available. The energy rebate shall be paid directly to the Owner. The Division 26 contractor shall cooperate with the Owner and the funding source to provide proof of purchase information, quantities involved, fill out forms, etc., to accommodate all required paperwork. Include all costs associated with this requirement.

1.5 QUALITY ASSURANCE

A. Luminaires shall be as specified in the "Luminaire Schedule". Luminaire types, appearance, characteristics, photometrics, finishes, etc., correspond to the specified manufacturer and associated series or catalog number listed in the "Luminaire Schedule". Products of other listed acceptable manufacturers shall be equivalent in every way to that of the luminaire specified. The Engineer reserves the right to disapprove any luminaire type submitted which they feel is not equal in quality, appearance or performance to the luminaire specified.

B. Manufacturer's luminaire series or catalog numbers listed in the "Luminaire Schedule" indicate quality, type, and style, but may not cover required special design details.

Provide luminaires having such special details as noted in the "Luminaire Schedule", as indicated by the specified luminaire model number and as required for proper installation.

C. All luminaires shall be new and bear a Nationally Recognized Testing Laboratories (NRTL) label for the service intended.

D. Luminaires shall be products of manufacturers regularly engaged in the manufacture of the type of luminaires specified and shall be the manufacturer's latest standard design that complies with specification requirements.

E. Verify the availability of all luminaires proposed to be used in the execution of the work prior to submitting same for approval. The discontinuance of production of any luminaire after such approval has been granted shall not relieve the Contractor from furnishing an approved luminaire of comparable quality and design at no additional cost.

F. Photometric and operational data shall be provided only by qualified and certified organizations. Certification documentation shall be submitted with the luminaire information.

G. Should there be any difference between drawings and schedules, secure from Architect/Engineer such information as necessary prior to providing proposal. When finishes are not definitely specified, they shall be as selected by the Architect and not be limited to standard finishes.

H. Locations indicated for luminaires are approximate. Field coordinate exact locations as near as possible to the location indicated. Coordinate with the Engineer for any major location changes.

1.6 SUBMITTALS

A. Product Data: For each luminaire type, include in a single submittal, in order of luminaire designation, the catalog "cut" sheet with complete manufacturer and model number. Product data should include the following:

1. Manufacturer and Catalog Number.

2. Features, accessories, materials and finishes.

3. Physical description and dimensions of luminaires.

4. Life, power input, output (lumens, distribution, CCT, and CRI) and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests (space to mounting height ratio, coefficient of utilization complete values, IES distribution, candlepower distribution by angle and luminaire efficiency). Format shall be in accordance with IES TM-27.

6. Power, signal, and control wiring diagrams between luminaires and controllers.

7. Lens/Louver Type.

8. Driver/ballast with each type luminaire as applicable (type, sound rating, overload protection, voltage, input/fixture wattage, ballast factor, power factor, etc.).

9. Integral battery inverters.

10. Emergency lighting units, including batteries and chargers.

11. Certification of IES LM-79, IES LM-80 and TM-21 testing for LED luminaires. Luminaires shall be tested in accordance with IES LM and TM standards.

12. Proof of Energy Star listing.

13. Warranty.

B. Coordination Drawings: Provide coordination drawings in accordance with Section 260500. Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structure members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including other luminaires, air outlets and inlets, speakers, sprinklers, access panels, ceiling mounted projectors, etc.

C. Color Chips: Provide color chips of available finishes for luminaires upon request of Architect/Engineer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Luminaires and equipment shall be delivered with NRTL and manufacturer's labels intact and legible. Broken, cracked and damaged materials and equipment shall be removed from the site immediately and be replaced with new materials and equipment. Luminaires and accessories shall be stored in protected dry locations in their original unbroken package or container. Luminaires shall be protected from dust and dampness both before and after installation. Luminaires shall be protected from paint and cleaning solvents during all phases of construction.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division hazard by a NRTL.

C. UL Compliance: Comply with UL 1598 and UL 8750.

D. Recessed Luminaires: Comply with NEMA LE 4.

2.2 LIGHT-EMITTING DIODE (LED) LUMINAIRES

A. Luminaires shall be identical in construction features, options and appearance to the luminaries specified in the Luminaire Schedule. LED luminaires include white and RGBW systems as indicated on the luminaire schedule.

B. Luminaires shall be provided with all cables, controllers, power supplies, drivers, connectors, terminators and accessories required for a complete installation. LED system shall utilize pulse width modulation, non-linear scaling techniques and reverse polarity protection.

C. Provide dimming down to 10% as a minimum, or to percentage indicated or called for on the drawings. Unless otherwise indicated, the dimming control shall be a 0-10VDC signal

D. RGBW LED systems where indicated shall be capable of at least 8-bit control of red, green, blue and white module. RGBW LED system shall be capable of setting each module with a unique and individual address. Each address shall be controlled independently by DMX or alternate method protocol. All RGB LED fixtures shall undergo a minimum of eight-hour burn-in testing during manufacturing.

E. LED luminaires shall be high brightness and binned for forward voltage, luminous flux and wavelength.

F. LED luminaires shall be tested in accordance with IESNA LM-79 (luminous output, power input, luminaire efficacy (lumens/watt), color temperature and color rendering index), IESNA LM-80 (L70, output luminous maintenance, 10,000 hour minimum test, calculation method is not acceptable) and IESNA TM-21/28. Luminaire output shall be a minimum of 100 lumens/watt. Rated life shall be a minimum of 50,000 hours at 70% output. Testing shall be performed by a US Department of Energy (DOE) accredited laboratory.

G. Drivers shall be solid state Class 1 power supply/driver with universal input (120-277V). The system shall have a minimum 90% power factor, 3.5 maximum crest factor, minimum efficiency of 90%, a maximum of 20% THD and overload protection. Adequate heat sink capability shall be provided to ensure the rated life. Unit shall meet FCC rules and regulations.

H. Where indicated luminaires shall have color tuning capability and control. System to have separate dimming (5-100%) and color (3000K to 5000K, or as indicated on drawings) adjustability. Control shall be Dali or DMX512 for controllability as indicated. The system shall utilize the most recent settings when energized.

I. The luminaire (to include LED sources and drivers) shall have a full five (5) year minimum warranty for replacement and labor.

1. Acceptable LED Node Manufacturers:

a. Philips
b. Osram
c. Cree
d. Nichea
e. Lumiled

J. LED Emergency Drivers:

1. LED emergency drivers shall have the following minimum requirements:

a. Operate indicated fixtures at full illumination for 90 minutes minimum.

b. Universal voltage input (120 to 277V).

c. Upon loss of normal power, fixtures shall automatically switch to battery power.

d. Upon restoration of normal power, fixture shall return to normal mode and charge battery.

e. Battery shall be maintenance free, nickel cadmium type with a minimum life expectancy of seven (7) years.

f. Driver shall be suitable for the environment installed.

g. Driver shall be Class 2 and enclosed entirely in the fixture (except for down lights and exterior locations).

h. Units shall be listed for UL924 -Emergency Lighting and Power Equipment.

i. Minimum five (5) year non-prorated full warranty.

j. Factory installed.

k. Shall include an emergency system test switch integral to fixture.

l. Unit shall be self-testing and provide indication of unit failure.

m. Design Make: Iota, ILB-CP series or approved equal.

2.3 LUMINAIRE CONSTRUCTION

A. Metal Parts:

1. Free of burrs and sharp corners and edges.

2. Sheet metal components shall be steel unless otherwise indicated.

3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Lenses:

1. Shall be listed materials tested in accordance with ASTM D-635, "Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position" and burns less than 2/5 inches per minute.

2. The products shall have a smoke density of less than 75 when tested in accordance with ASTM D-2843, standard test method for "Density of Smoke from the Burning or Decomposition of Plastics".

3. The flame spread rating shall not exceed 0-25 and smoke developed rating shall not exceed 450 in accordance with ASTM E-84, standard test method for "Surface Burning Characteristics of Building Materials".

4. Self-ignition shall not occur below 600°F, in accordance with ASTM D-1929, standard test method for "Ignition Properties of Plastics".

5. Materials shall remain in place 15 minutes at 175°F and fall from frame at 200° below ignition temperature in accordance with ASTM D-648, "Deflection Temperature of Plastics Under Flexural Load".

2.4 LUMINAIRE SCHEDULE

A. Luminaire schedule is found on the contract drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. Comply with NECA 1.

B. All luminaires shall be installed as per manufacturer furnished installation instructions.

C. Provide for every luminaire as shown on the plans, or as scheduled on the drawings.

D. Location of all ceiling and wall mounted luminaires shall be as indicated on the Architectural and Electrical drawings. The contractor shall verify ceiling type, construction, and material prior to ordering.

E. Provide luminaires with an IC rating for luminaires installed in direct contact with insulation.

F. Provide plaster frames for plaster ceilings and flanged frames for drywall ceilings.

G. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

H. Luminaires shall be suitable and as recommended by the manufacturer for the actual intended mounting method and materials.

I. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

J. Flush-Mounted Luminaires:

1. Secured to outlet box.

2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.

3. Trim ring flush with finished surface.

K. Wall-Mounted Luminaires:

1. Attached to structural members in walls, to a minimum 20 gauge backing plate attached to wall structural members, or using through bolts and backing plates on either side of wall.

2. Do not attach luminaires directly to gypsum board.

L. Suspended Luminaires:

1. Pendant and Rods:

a. Pendant mount luminaires from 1/4 in. threaded rods of required length.

b. Sleeve threaded rods with 1/2 in. EMT painted with color as directed by Architect/Engineer.

c. Brace pendants and rods longer than 48 inches to limit swinging.

2. Aircraft Cable:

a. Cables shall be 1/16 in. aircraft cable with end safety fittings. Cable shall be provided with 2 in. diameter mini-canopy and threaded coupler for attachment to a 1/4 in.-20 threaded stud extending 3/4 in. below ceiling.

b. Cable assembly shall include a spring-loaded adjustment device mounted in the fixture.

c. The Contractor shall be responsible for providing required supports for cable attachment.

d. For cord feed to the luminaire provide continuous cord clip of matching color to attach the cord to the cable.

e. Support per manufacturer's recommendations.

3. Support stem mounted, single unit luminaires with approved outlet box and accessories that hold tem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

4. Use tubing or stem for wiring at one point of continuous rows of luminaires and tubing, rod, or wire support for suspension for each unit of length of luminaire chassis, including one at each end.

M. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.

2. Use approved devices and support components to connect luminaire to building structure in a minimum of four locations, spaced near corners of luminaire. Utilize #10 steel wire; similar to that used to support the ceiling grid.

3. Provide UL listed seismic hold-down clips and fasten to luminaires and to ceiling grid members at or near each luminaire corner.

4. Install luminaires of sizes less than ceiling grid as indicated on reflected ceiling plans or center in acoustical panel and support luminaire independently with at least two metal channels spanning and secured to ceiling tees.

N. Cove Lighting:

1. Installed so as to produce a continuous and unbroken band of light with no shadows or light gaps.

O. In-Grade Luminaires:

1. Provide a minimum of 6 in. peat gravel at the bottom of luminaire to allow for drainage. When installed in a concrete walkway, secure luminaire to rebar to prevent luminaire from "floating" when concrete is poured.

2. Seal conduit entry into luminaire to prevent moisture penetration into luminaire from conduit system.

3. Secure faceplate of in-grade luminaires in accordance with manufacturer directions to compress gasket evenly to form a waterproof seal. The use of power tools to secure faceplate is not permitted.

P. Provide all necessary accessories for "end-to-end" mounting where continuous rows of luminaires are indicated. All luminaire assemblies shall be grounded.

Q. Luminaires installed in continuous rows may be fed by a single outlet if luminaires are UL approved and suitable for through wiring in luminaire raceway.

R. New luminaires may be provided to replace existing luminaires indicated to remain or be reused, subject to shop drawing approval.

3.3 REMOTE BALLASTS/DRIVERS

A. Remote ballasts shall be mounted in an approved NEMA 1 enclosure. Remote ballasts shall be located in areas easily accessible to maintenance personnel.

B. Wiring from luminaire to remote ballast shall not exceed the ballast manufacturer's recommendations for distance.

C. Remote ballast shall be clearly labeled indicating fixture served, voltage, panelboard and circuit number served from.

3.4 GROUNDING

A. Ground all non-current carrying parts of all lighting luminaires.

B. All grounding shall be accomplished with NRTL tested grounding connectors suitable for this purpose.

3.5 LABELING

A. Attach a self-adhesive red dot label, 1/2 in. in diameter, to all luminaires with an integral battery backup and/or those tied into an emergency generator. Labels shall be attached to these fixtures or to adjacent ceiling tiles so that they are readily discernible for testing and maintenance purposes.

3.6 FINAL CLEANING

A. Immediately prior to acceptance, damp clean diffusers, glassware, luminaire trim, reflectors, lamps, louvers, lens and similar objects of all luminaires. Remove all dirt, corrosion, foreign material, finger marks, and blemishes. Replace all burned out lamps and failed components.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test of Emergency Lighting: Under supervision of Engineer, interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

D. Replace luminaires damaged during shipment, construction, or installation.

3.8 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260936 "Lighting Controls."

3.9 ADJUSTING

A. Provide adjusting the direction of aim of luminaires to suit occupied conditions. Adjustment may be required during hours of darkness.

B. Final distribution shall be acceptable to the Owner and may take several attempts.

END OF SECTION

SECTION 270510 - COMMUNICATIONS, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents. This section specifies general wiring requirements for systems provided under 27 Series sections of these specifications.

1.2 SUBMITTALS

A. Refer to particular Specification Sections covering all systems. Submit system test reports as called for.

1.3 GENERAL REQUIREMENTS

A. Provide conduit systems and special systems as called for.

1. Provide conduit, wireway, wire terminations, etc., necessary to provide for system functions.

2. Cross-sectional area of wires installed in a conduit shall not exceed 40% of the cross-sectional area called for in the National Electrical Code.

3. Provide separate circuit power source for each system.

4. Where allowable by Code and contract documents, special systems wiring may be installed without conduit. Installation and wire insulation types shall be as described by NEC, Article 725. All low voltage wiring circuits 50V and under shall:

a. Be adequately supported using bridle rings or other approved method when installed horizontally above accessible ceilings or run exposed in unfinished areas.

b. Be run in wall cavity or surface metal raceway where no access is available to wall cavity, in finished areas.

c. Be installed in conduit when installed vertically in Mechanical Rooms from panels and devices up to ceiling.

d. Be installed in conduit in all cases not specifically covered by the above cases, or where subject to physical damage.

e. Have the proper insulation and meet the requirements of NEC Article 300-22 when installed in plenums or other spaces used for environmental air.

B. Identification:

1. Provide consistent color code wiring and identify with permanently attached number to each end of each wire, except where color coding is prohibited to meet UL burglary protection requirements.

C. Termination:

1. Unless special terminations are required, such as coaxial cable termination, wires shall be terminated on screw type terminal blocks with metal terminal cabinets.

D. Wiring Diagrams:

1. Install systems in accordance with manufacturer's certified correct wiring diagrams.

2. Provide record drawings for each system, with wire identification, numbers and colors, as installed.

PART 2 - PRODUCTS

2.1 MAKE AND SERVICE

A. Provide devices and equipment by an established manufacturer for respective systems. All devices and equipment for which there is a listing shall be UL listed and FM approved.

B. Provide system equipment and devices of one manufacturer who maintains a competent service organization and who shall be prepared to offer a service contract for maintenance of the respective system.

C. Provide three service organization inspections for each system at four-month intervals during the year following final acceptance.

D. Correct defects found in the system at the time of these inspections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide complete installation in a neat and workmanlike manner including all accessories and appurtenances for a complete operating system, including equipment mounting backboards, power supplies, wiring, etc.

B. Each system installation shall be supervised, tested, adjusted and approved by authorized representative of the manufacturer of the system devices and equipment.

C. Provide written statement from the authorized representative of the manufacturer of the system devices and equipment that the completed system has been inspected and tested and is approved.

D. Riser and wiring diagrams are not intended as final installation drawings but only as a guide for bidding. Install system based on final wiring drawings prepared by the manufacturer of the system.

3.2 WIRING

A. Wire sizes shall be as recommended by system manufacturer.

B. #14 AWG wire, minimum unless otherwise called for.

C. #12 AWG wire, minimum for alarm signal circuits and all power supplies.

D. Provide #20/2 copper minimum twisted and shielded with overall jacket for audio frequency circuits. Shield shall be Mylar backed aluminum foil with drain wire, or copper braid. Do not provide spiral wrap shielding.

E. Provide coaxial cable as called for, for video and RF distribution.

F. Do not install low level lines such as microphone wires in same conduit with high level lines such as speaker wires.

G. All final wire connections and terminations shall be performed by an authorized representative of the equipment manufacturer who is regularly engaged in, and experienced in this type of work. Subcontracting this work to others is not acceptable.

END OF SECTION

SECTION 272100 - LOCAL AREA NETWORK SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment, services, etc. for a Local Area Network (LAN) system. Provide cabling and final terminations to head end equipment furnished by others.

B. The systems to be provided shall be for a switched LAN environment. The system shall hereafter be referred to as the Data Network System.

C. Basic Intent:

1. Located throughout the building as shown on the drawings, are places where computers and associated equipment are intended to be placed and connected to the network for the purposes of utilizing common resources.

2. The telecommunications room for the data network in the building is located as shown on the drawings.

3. From the telecommunications room, data cables are to be run to the data jacks indicated on the drawings.

D. Scope of Work:

1. The scope of work shall include the items listed below, as described herein and as indicated on the Contract Documents:

a. Horizontal cabling.

b. Complete raceway system (cable tray, J hooks, and conduit) for cabling distribution.

c. Ground of all racks, raceway and equipment.

d. Power for the telecommunication rooms.

1.2 REFERENCE STANDARDS

A. ANSI/TIA/EIA Telecommunications Building Wiring Standards.

B. IEEE Telecommunications Standards.

C. BICSI Methods Manuals.

1.3 QUALITY ASSURANCE

A. Work shall be as specified herein and it shall be neat and orderly installation. All methods of construction, details of workmanship that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative.

B. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

C. Installation shall be accordance with NFPA-70 (National Electrical Code), TIA/EIA, IEEE, IEC, state codes, local codes, and requirements of the authority having jurisdiction.

D. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMAIEC, TIA/EIA and IEEE Standards.

E. Each item shall be NRTL tested and listed.

F. The system provider must:

1. Provide equipment from manufacturers for which they maintain a contract, distributorship, are an agent, or other formal arrangement for which documentation can be produced showing authority to sell and service the equipment in this territory.

2. Demonstrate that they have successfully installed these systems, utilizing their standard products, for a period of five (5) years.

3. Maintain a service organization to provide both normal and emergency service. Emergency service must be available 24 hours per day; 365 days per year and staff must be adequate to respond within 2 hours of an emergency call.

4. Maintain adequate spare parts inventory to provide both normal and emergency service.

5. Employ service technicians who are trained in accordance with the systems manufacturer's recommendations.

6. Own and demonstrate proficiency in the use of the required test equipment, tools, etc. for the proper installation, set-up, testing and maintenance of the system. If requested, must provide a listing of tools and/or equipment and where appropriate, certifications in the proper training and use of the tools and/or equipment.

1.4 SUBMITTALS

A. Provide the following in a single clear and organized submittal. Package shall be submitted as specified in:

1. Manufacturers catalog sheets, specifications and installation instructions for all components.

2. Dimensioned drawings of all system control cabinets and layouts for all equipment rooms.

3. Cut sheets on all cables.

1.5 SYSTEM DESCRIPTION

A. Provide cabling and raceways for a state of the art Category 6 Local Area Network (LAN).

B. The system shall include, but is not limited to, the following:

1. Equipment cabinets and racks.

2. Premises wiring.

3. Modular jacks, backboxes and faceplates.

4. Terminations and testing.

5. Raceways.

C. The work included in this section is shown on the drawings or described in the specifications, and consists of furnishing all labor, material, services, and skilled supervision necessary for the construction, erection, installation, and connection of all circuits, apparatus, and equipment specified herein or shown on the drawings in a first class, workmanlike manner, and its delivery to the Owner ready for use.

D. Each part of work is to be complete in detail and operable in unison with all other sections, to constitute completely installed computer network systems and connections of same, as shown on drawings and described in specifications.

E. Any other electrical work not listed in this scope of work but shown or specified in the contract documents.

F. Deliver all materials to be stored on site in protective containers. These protective containers shall be clearly marked with unit designation as indicated on drawings or specifications.

G. Owner shall provide the network electronics.

PART 2 - PRODUCTS

2.1 HORIZONTAL SYSTEM PARAMETERS

A. Category 6 UTP Cable:

1. Initially, the manufacturer shall perform qualification tests on each cable. These tests shall be performed in accordance with the latest revision of the ANSI/TIA/EIA 568-B.2 standard prior to shipment.

2. The completed cable, while on the shipping reel, shall be tested at room temperature to insure it meets or exceeds the design specifications. Submit test results to Engineers for review and comment before proceeding.

3. Certification shall be provided to show the results of the tests for each reel.

4. Date of Manufacture: No insulated cable over one year old, from date of manufacture when installed, shall be acceptable.

5. Cable shall have a ripcord.

6. Cable shall be plenum rated, 4 pair, 100 OHM, 23 AWG.

7. Cable shall meet all requirements of FCC 68, the latest revision of the TIA/EIA 568B and Addendums.

8. Cable shall have blue colored thermoplastic jacket with overall diameter not to exceed .365" x .165".

9. The cable pulling tension shall be rated for 25 pounds minimum.

10. Cable shall be able to withstand a minimum bend radius of 1.0 inches at -20ºC without insulation cracking.

11. Cable shall be color coded in accordance with the latest revision of the TIA/EIA T568B polarization sequence.

12. Cable shall not exceed maximum length of 90 meters.

13. Performance:

    a. Less than 9.000 ohm per 100 m DC resistance.

    b. Less than 15 pF/ft. at 1 KHz, mutual capacitance.

    c. Characteristic impedance shall be 100 ohm ±22% from 1 MHz to 350 MHz.

    d. Return loss > 17.3dB at 250 MHz.

e. Insertion Loss < 32.8 dB/100M at 250 MHz.

f. Near end cross talk (NEXT)> 38.3 dB at 250 MHz.

g. Power Sum - near end cross talk (PS-NEXT)> 36.3 dB at 250 MHz.

h. Equal level far end cross talk (ELfEXT) > 19.8 dB at 250 MHz.

i. Power Sum - equal level far end cross talk (PS-ELfEXT) > 16,8 dB at 250 MHz.

j. DC resistance unbalance between any two conductors of any pair shall not exceed 3%.

k. The capacitance unbalance of any pair to ground shall not exceed 33.0pF per 100 meters.

l. Delay < 538 ns at 100MHz.

m. Delay skew < 45 ns at 100MHz.

n. Cable shall be ANSI/TIA/EIA-568.B.2 Category 6 compliant. The cable shall be tested and characterized by the manufacturer to 500 MHz.

14. Acceptable Manufacturers:

a. Belden

b. Berk-Tek

B. UTP Telecommunications Outlets/Connectors:

1. Physical Specifications:

a. Shall be 8-pin connector compatible with the latest revisions to match the cable characteristics.

b. Shall be modular and snap-in to user configurable faceplates for future retrofits meeting durability requirements specified in the latest revision of the CEI/IEC standard.

c. Shall be IDC type suitable for eight 22-24 AWG wires with a gas-tight connection.

d. Each contact surface shall have at a minimum, copper alloy with 50 micro-inches gold over nickel and a minimum contact force of 100g.

e. Conductors shall be separated and aligned internally by jack comb.

f. Shall have easy to read 568A/B color scheme to prevent termination errors.

g. Wired in accordance with TIA/EIA polarization sequence specified in Patch Panel section of this specification.

h. Transmission characteristics shall meet the requirements for the UTP cabling specified.

i. Minimum durability shall be 1000 mating cycles.

2. Acceptable Manufacturers:

a. Ortronics

b. Panduit

c. Belden

C. Color Coding:

1. Cable outer jacket shall follow the color coding scheme as follows. Jacket color shall be continuous. Patch cords shall also follow this.

2. Copper Cable:

a. Data Communication:

1) Category 6 - Blue

b. Voice Communication:

1) Category 6 - Blue

c. WiFi - Green / Purple

d. CCTV - Green / Mauve

e. Data - Blue / Yellow

f. Voice - Beige / Gray

g. Paging - White

2.2 LABELING

A. Copper Data:

1. Cabling

a. Specifically label cables at each termination point indicating the destination room, rack number and port number.

2. Field Outlets:

   a. Each data port shall have an identical label to the opposite end port.

   b. The Contractor shall utilize Interlink-Label for Windows 2 or approved equal; Network Labeling System to label all patch panel ports. Labels shall be installed in a workman-like manner and fit completely in the recessed area of the labeled location.

   c. Contractor shall utilize Interlink Icon labels at Poke-thru locations and any other locations that do not have a label location.

3. Each label shall contain the Telecommunication Room designated, the room number and the port number in the room. Verify color of label and size of font prior to completion. Provide samples as required.

4. Labels shall correspond to the room/names/numbers upon completion of the project. Contractor shall not necessarily utilize existing room/names/numbers or those indicated on the blueprints.

B. Contractor shall record each data port label on all record drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cable:

1. Provide a minimum of one (1) UTP cable to each RJ45 jack from respective equipment/telecommunications room as called for. Quantity of data jacks equals minimum quantity of UTP cables (typical).

2. All risers, and wiring concealed in walls or soffits, shall be installed in metal conduits.

3. All cable above accessible ceilings shall be installed in cable tray or J-hook style cable rings 3 ft. O.C. Refer to Specification Section 260501.

4. Provide wire management and Velcro cable wraps every 6 inches throughout closets. Provide Velcro cable wraps every 36 inches elsewhere.

5. Verify all wiring requirements with the Manufacturer. If the manufacturer recommends larger wire sizes, they shall be provided. However, smaller sizes or lower cable categories are not acceptable.

6. Install UTP cable in accordance with latest revision of TIA/EIA 568 standards.

7. The Contractor shall be responsible for replacing all cables that do not pass required bandwidth and throughput tests.

8. All raceways and closets shall be installed in accordance with latest revision of TIA/EIA-569.

9. All cables shall be labeled in accordance with latest revision of TIA/EIA 606.

10. All horizontal cables shall be terminated in patch panels at the distribution frames, and at the UTP jack at the telecommunications outlet.

11. Maximum length shall be 90 meters.

B. Terminations:

1. All terminations shall be made by a manufacturer's authorized representative.

2. Use termination kits for fiber and UTP that are approved by manufacturer of the cable.

3. All backbone cable shall be terminated in a patch panel and all connections between horizontal and backbone cables shall be via cross connect cable.

C. Equipment and Devices:

1. Install all devices where shown on drawings. Provide all necessary conduit outlet boxes, junction boxes, supports, etc. Verify all required box sizes with the system supplier. All devices shall be modular for future moves and changes.

2. Install all equipment in specified 19 in. racks/cabinets leaving minimum 30 in. of access space on sides and back of rack and 36 in. in front of rack.

3. Provide all power outlets and plug strips required for system operation but not shown on plans.

D. Raceways:

1. Minimum size raceway shall be 1 inch.

2. Minimum back box size for telecommunications outlet locations shall be two-gang; no single-gang boxes allowed.

E. Data Network Ground System:

1. Provide grounding system for all equipment rooms and telecommunication rooms as called for in Specification Section 260526.

2. Provide 3/4" x 4' high continuous plywood backboard with two coats of medium gray fireproof paint in telecommunications room.

3.2 TESTING

A. Copper Cable: System supplier shall channel test end-to-end each permanent link connection using latest 500 MHz for Cat 6a 1000 Mbps IEEE testing procedure. (Tester must conform to the latest standards at the time of testing not time of bid). Provide a full test using Fluke DTX-1800 with latest software version, or approved equivalent. Testing shall be performed by a technician trained with the specific testing equipment. Testing shall be witnessed by the Owner's Representative.

B. Replace any cables and connectors that do not meet or exceed standards referenced and stated herein and then tested. Testing shall be end-to-end / port-to-port for each cable.

C. Test equipment shall be in good condition and working order, calibrated within one year of its use and utilize leads without twisting and kinks. Unit calibration shall be in accordance with Level III Field Tester per ANSI/TIA 1152.

D. Test Reporting

1. The field testing shall be accurately documented for submission, inclusion in O&M Manuals and for Owner future use.

2. Test reports shall include data directory table cross-referencing room numbers and cable numbers with the test report. Post copies of directory at telecommunications room location.

3. Report shall utilize electronic Windows based documenting with a hard and electronic copy provided to the Owner.

4. The report documentation for each cable test shall include the following as a minimum:

a. Project name.

b. Test equipment manufacturer and model number, and last calibration date.

c. Date and time of the test.

d. Patch panel identification.

e. Cable identification.

f. Cable type.

g. Pass/Fail: Pass indicating meeting or exceeding the identified criteria or standard (whichever more stringent) for all parameters. Fail indicating test not meeting identified criteria for one or more parameters.

h. Cable length.

i. Propogation delay and attainable bandwidth.

j. List of tested parameters with test and allowable values. Any failed parameters shall be noted or highlighted.

3.3 WARRANTY

A. All cable plant parts shall be warranted to the owner for a period of 15 years as a complete end-to-end system.

B. All network equipment shall be warranted to the owner for a period of one (1) year two (2) years. Provide technical support at no charge to the customer for a period of one (1) year after system has been commissioned.

C. Make available an extended warranty to the customer.

D. Warranties shall commence upon final acceptance of the system.

END OF SECTION

SECTION 283102 - ANALOG ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation of a fully operational analog addressable fire alarm system and related Work as described in the Contract Documents.

B. Provide system as approved by local Fire Marshal and the Authority Having Jurisdiction (AHJ). System materials and installation shall be in accordance with the manufacturer's recommendations.

1.2 QUALITY ASSURANCE

A. All methods of construction, details of workmanship that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by those manufacturers. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

B. Installation shall be in accordance with NFPA-70 (National Electrical Code), NFPA-72 (National Fire Alarm Code), AHJ, state codes, local codes, requirements of authority having jurisdiction and the contract documents. Installer shall be certified in the State of New York for fire alarm installation.

C. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published UL, NFPA, ANSI, NEMA and IEEE Standards. All system equipment shall be compatible and of the same manufacturer.

D. Each item of the fire alarm system shall be listed as a product of a single fire alarm system manufacturer and shall bear the UL Label.

E. System installation shall be under the supervision of an accredited factory representative. Final connections to the FACP, annunciator panel and any other panels shall be by the factory representative.

F. The system provider must:

1. Provide equipment from a single manufacturer for which they maintain a contract, distributorship, are an agent, or other formal arrangement for which documentation can be produced showing authority to sell and service the equipment in this territory.

2. Demonstrate that they have successfully installed these systems, utilizing their standard products, for a period of five (5) years minimum.

3. Maintain a service organization to provide both normal and emergency service. Emergency service must be available 24 hours per day, 365 days per year and staff must be adequate to respond within 2 hours of an emergency call.

4. Have a service location not more than 50 miles from the project location.

5. Maintain adequate spare parts inventory to provide both normal and emergency service.

6. Employ service technicians who are trained in accordance with the systems manufacturer's recommendations.

7. Own and demonstrate proficiency in the use of the required test equipment, tools, etc. for the proper installation, set-up, testing and maintenance of the system. If requested, provide a listing of tools and/or equipment and where appropriate, certifications in the proper training and use of the tools and/or equipment.

8. Provide all system programming to deliver a customized system to the Owner ready for use.

9. All system programming is to be completed to the satisfaction of the Owner. If after preliminary use of the system, and/or training, the increased understanding of the system's features and capabilities necessitates reprogramming to any extent, it is to be performed at no additional cost.

10. Provide a minimum of two system inspections/tests each year during the warranty period as described in NFPA 72. Needed and requested system programming changes shall be provided at these times.

11. Warranty period shall be as described elsewhere with two years being minimum. Provide a service contract for the Owner review for two years beyond the warranty period. Warranty shall include all parts, materials, labor, transportation, etc.

1.3 SYSTEM DESCRIPTION

A. The system shall constantly monitor all initiation devices and notification circuits for any abnormalities or alarm conditions. System shall sample/poll each addressable device no less than every 10 seconds.

B. The system operation subsequent to the alarm activation by any initiating device (manual station, automatic detector, sensor, sprinkler flow switch, etc.) shall be as follows:

1. All audible alarm notification appliances within corresponding building or designated area shall provide a common audible fire alarm signal until the System Reset Key or the Signal Silence Key is depressed.

2. All visual alarm notification appliances shall flash continuously and synchronized until the system is reset or silenced.

3. The remote central monitoring station shall be notified automatically until the System Reset Key or the Signal Silence Key is depressed.

4. Shutdown of the corresponding HVAC system equipment shall occur with a supervisory alarm until the system is reset. All fans over 2000 cfm shall be shut down.

5. Activation of all programmed outputs assigned to the initiating device shall occur until the system is reset or the silence key is depressed.

6. The alarm shall be displayed at the local Fire Alarm Control Panel (FACP) and the fire alarm annunciator panel.

7. The system alarm LED shall flash on the control panel and the fire alarm annunciator panel until the alarm has been acknowledged/reset. Once acknowledged, this same LED shall latch on. A subsequent alarm received shall flash the system alarm LED on the control panel and annunciator. The LCD display shall show the new alarm information.

8. A pulsing audible alarm tone shall occur within the local building control panel and, where applicable, the fire alarm annunciator panel until the event has been acknowledged.

9. Alarms shall be entered into the system event log history.

10. Refer to Appendix A for operational/sequence matrix.

C. Any subsequent alarm shall follow the operation described above.

D. The activation by any system smoke detector or sensor shall initiate an alarm verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If, within a preset time after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within the prescribed time, the system shall resume normal operation. The alarm verification shall operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation shall be selectable by device.

E. A manual evacuation (drill) switch shall be provided to operate the alarm notification appliances without causing other control circuits to be activated. However, should an actual alarm occur, all alarm functions shall occur as described previously.

F. The system shall have a password(s) to allow the operator to display all alarms, troubles, and supervisory service conditions log history including the time of each occurrence. This shall be able to be viewed from the front of the control panel, annunciator panel or from a computer connected to the FACP.

G. The actuation of the " walk test" program at the control panel shall activate the "Walk Test" mode of the system which shall cause the following to occur:

1. The remote central monitoring station connection shall be bypassed.

2. Only audible and visual appliances shall be operated. Other alarm functions (elevator recall, HVAC shutdown, etc.) shall not be affected.

3. Walk test shall be selectable by circuit or circuits.

4. Actual alarms received during a "Walk Test" shall cause the control panel to go into alarm and override the walk test mode.

5. The control panel shall show trouble conditions.

6. The walk test activation of any initiation device shall cause the audible signals to activate for two seconds or a distinguishable audible.

7. The panel shall automatically reset itself after signaling is complete.

8. The control panel shall automatically return to normal condition if there is no activity on a walk test circuit for a period of 30 minutes.

H. Any momentary opening of an initiating or notification appliance circuit wiring shall cause an audible signal to sound at the Fire Alarm Control Panel and, where applicable, the annunciator panel for four seconds indicating a trouble condition.

I. Elevator Operation:

1. Provide the following equipment as a minimum and as indicated on the drawings:

a. Smoke detection in the elevator equipment room.

b. Smoke detection at each elevator lobby.

c. Smoke detection in the elevator shaft if a smoke hatch.

d. Heat detection in the equipment room and shaft (high and low) if a sprinkler system is in the area. Detectors shall be within 2 ft. of the individual sprinkler heads.

e. Detection devices located in elevator lobbies, elevator hoistways and elevator machine rooms shall be used for elevator recall. Hoistway and equipment room heat detection shall initiate power shut down prior to water flow. Operation shall be in accordance with ASME A17.1, Safety Code for Elevators and Escalators. Signals shall be provided to the elevator controls for main level lobby alarm, any lobby alarm, elevator equipment room alarm and elevator hoistway alarm as a minimum. Provide addressable control modules for the signals to the elevator controls.

J. Alarm initiation of a detector associated with a smoke hatch or fire barrier shall initiate a system alarm. Also, provide connections between the auxiliary contacts on the detectors or addressable control module and the associated smoke hatches and fire barriers such that the smoke hatch or fire barriers will be operated upon its respective detector activation. Provide power supplies, wiring and accessories for fire alarm system and all supervisory functions required for proper smoke hatch and fire barriers operation.

K. Duct mounted smoke detectors associated with duct dampers shall have an addressable control module to operate the duct damper. In the event of an alarm initiation by the duct mounted smoke detector or the associated air handling unit/fan shut down the duct damper shall be closed. Control wiring shall be provided to shut the damper(s) when the associated air handling unit is not operational. Provide power supplies, wiring and accessories as needed for this operation.

L. Provide wiring and equipment such that alarm initiation of a heat detector located in the elevator machine room and/or the elevator shaft shall provide suitable voltage from the fire alarm control panel to be applied to the shunt trip coil of the elevator's supply circuit breaker. No fire alarm devices except the heat detectors in the elevator machine rooms and shaft shall cause this. Also, alarm initiation of these heat detectors shall initiate the system alarm functions described above. Provide an addressable control module with a Form C contact at the elevator controllers, which shall be normally closed and shall open upon alarm initiation of any of these heat detectors; this contact shall be used to disconnect the battery-powered emergency return unit if so equipped with the use of a relay suitable for the emergency power circuit. Also, provide an auxiliary contact on the main line disconnect switch (four pole unit) and two (2) #12 in conduit to the elevator controller from this contact for the same purpose.

M. Provide a minimum of two Form C contacts at the building's fire alarm control panel. This contact shall activate upon activation of any fire alarm initiating device.

1.4 SUPERVISION

A. The system shall utilize independently supervised initiation device circuits. The alarm activation of any initiation device shall not prevent the subsequent alarm operation of any other initiation device.

B. Notification appliance circuits shall be supervised to indicate an open or short circuit condition.

C. The incoming power to the system shall be supervised so that any power failure must be audible and visually indicated at the control panel and the remote annunciator. A green "power on" LED shall be displayed continuously while incoming power is present. This shall be a trouble alarm.

D. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel and the remote annunciator. This shall be a trouble alarm.

E. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

1.5 SUBMITTALS

A. Provide a complete system submittal prior to ordering of equipment and installation including but not limited to:

1. Complete equipment list.

2. Catalog descriptive literature for all equipment. This shall include a description of the unit, ratings, functions, capability, materials and compatibility with other components.

3. Riser Wiring Diagram showing all equipment, devices, device addresses, connections, control connections, remote notification connection(s), wire quantities and sizes.

4. Floor plan indicating equipment and device locations, addresses, power circuit information with power panel location, notification circuiting, initiation circuiting, control circuiting and any system applicable building characteristics (ceiling heights, structural members impeding detection, etc.). Contact the Engineer for an electronic copy of the project floor plans. Engineer logo shall be included in final drawing.

5. Typical Terminal Wiring Diagram for each type of device.

6. Terminal wiring Diagram for all Fire Alarm equipment.

7. Calculations including:

   a. Battery sizing calculations indicating total number of power devices, load associated with each type device, backup period and recommended battery capacity (AH).

   b. Voltage drop calculations with actual equipment loads used to derive battery back-up ampere-hour rating and individual circuit voltage drop (indicate the wire size to be used and the associated voltage drop with the allowed voltage drop) for each circuit.

8. Complete console enclosure and equipment configuration.

B. Submittal package, calculations and system wiring shall be performed/collected/signed by a NICET Level III technician.

C. If required by the Authority Having Jurisdiction (AHJ) provide a submission of all requested information for review and comment by the AHJ. All AHJ comments shall be incorporated and resubmitted until approved.

D. Test reports at the completion of the project. Testing shall be of all system devices, equipment, circuits, features and functions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The project fire alarm system shall comply with and be in accordance with the drawings and specifications. All system equipment and materials shall be of the same manufacturer unless otherwise indicated. System and component acceptable manufacturers include the following unless otherwise indicated:

1. Notifier (Basis of Design)

2. Simplex

3. Pyrotronics - Siemens

4. EST - GE

2.2 FIRE ALARM SYSTEM

A. The fire alarm system shall be comprised of the components specified as a minimum and also include components not indicated but required for a complete and operable system as described herein.

B. The system and all its components shall be UL listed and in accordance with NFPA 72, local and state codes.

C. The system shall have 25% spare capacity. This shall include all individual notification circuits, initiation circuits, initiating modules, alarm modules, power supplies, batteries, central processing unit memory and printed circuit card space. System initiation device and control device capacity shall be a minimum of the indicated percentage over the shown quantity or 250 whichever is greater.

D. Each initiating device shall have an individual address for system communication. The system addresses shall not exceed seven digits. Each address, initiation circuit, notification circuit and control point shall have an individual identification description.

E. System shall shut down all air handlers more than 1,000 cfm upon an alarm.

2.3 FIRE ALARM CONTROL PANEL (FACP)

A. The system shall be entirely solid state, microprocessor based, use digital transmission and shall be field programmable. All system programming including field modifications shall be stored in non-volatile memory. Field modifications shall be automatically stored without special actions. The panel shall be designed and manufactured expressly for the intent to detect the presence of fire and to provide indication of such detection. Panel shall contain as a minimum power supply(s), control module, main control printed circuit board, initiation modules, notification modules, terminals and back up battery(s). Control module shall have 80 character backlit LCD display and twelve control buttons (four being field assignable), minimum. Display shall indicate the battery voltage at all times.

B. The system shall be modular in design to allow for future expansion with a minimum of hardware additions.

C. The FACP shall be located where shown on the drawings. Enclosures shall accept all system items for an aesthetically suitable operator's console. Enclosures shall be of modular size to allow surface mounting of multiple boxes adjacent to each other, shall have hinged solid metal doors and contain a lock with a key common to all system devices. Enclosure shall have a red finish.

D. The FACP shall operate its integral LCD Display through an RS-232C port operating up to 9600 baud to indicate all operator transactions, alarms, trouble reports and any other conditions specified by system programming.

E. Conditions of the system shall be indicated at the operator interface by LED's. These conditions shall be alarm, supervisory, trouble and alarm silenced. An LCD 2 line, 40 character per line display shall also be included. It shall display "SYSTEM IS NORMAL" with the date and time under normal circumstances. The LCD display shall also indicate type of alarm, point status, number of alarms and location. Through the use of function keys, historical data can also be displayed.

F. The FACP shall include a password (three (3) levels of protection with individual passwords, minimum) protected key pad for access to programming, special functions and all system features.

G. Any event initiated by the FACP due to an alarm input shall be retained in nonvolatile EPROM memory. The FACP shall also have sufficient memory for 1200 individual alarm/trouble events.

H. The FACP shall have the following user connection types:

1. Ethernet connection for a computer, personal data device or printer. Connection shall allow for programming changes, history download, setting review/changes, etc.

2. RS 232 port for connection of a serial printer.

I. Battery and charger shall be as specified within this section.

J. Design Equipment: Notifier FireWarden-100

2.4 VENTILATION FAN SHUTDOWN CONTROL

A. Provide supervised normally closed relays and contactors for connection into the fan motor control circuits ahead of all automatic devices.

B. Sequence fan shutdown for every air distribution system over 1000 cfm. Provide duct detectors in return of systems over 2,000 cfm and in return at each floor of systems over 15,000 cfm.

C. Provide drill bypass feature, locate switch on Fire Alarm Control Panel and label "DRILL-FAN SHUTDOWN BYPASS". Buzzer shall sound continuously while in bypass mode.

D. Provide fan reset feature, locate switch on Fire Alarm Control Panel and label "FAN RESET".

2.5 INITIATION DEVICES

A. General:

1. Provide analog addressable smoke and thermal sensors as shown. All detectors, control modules, monitor modules and all other initiation devices shall communicate with twisted pair cable and have an individual address. Peripheral devices shall be of the some manufacturer as the FACP.

2. Spot type detectors shall utilize the same interchangeable bases.

3. If a device is removed or taken out of service a trouble signal shall be initiated.

B. Photo-Obscuration Type Smoke Detector:

1. The photo-obscuration detector shall operate on the photo electronic principle and provide an analog signal to the system indicating the amount of smoke. Detector shall be an analog addressable type.

2. The detector shall incorporate a built in type identification so the system can identify the type of detector. The sensor shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, smoke, temperature, humidity, etc.). Unit shall not be affected by exterior light or EMF.

3. The detector shall be designed and arranged to prevent interference from exterior electromagnetic fields and light.

4. The detector shall provide advance indication of the analog value of the products of combustion to the FACP indicating that maintenance is required in order to insure normal operation. The detector sensitivity shall be adjustable per device (within UL limits) and be set at the FACP for continuous or variable based on time of day. There shall be a minimum of six (6) selectable sensitivity levels. The individual detector sensitivity setting shall be adjusted to meet the building/space characteristics and operation. The detector shall monitor the obscuration continuously and raise the obscuration level to compensate for a dirty sensor to maintain the set sensitivity.

5. Detectors shall be designed for twistlock mounting to a separate base assembly. Provide manufacturer's recommended back box suitable for surface mounting where required.

6. The detector base shall have terminals for making all connections; no soldering shall be required. It shall be possible to secure the detector to the base with a concealed socket headscrew to prevent unauthorized tampering.

7. Smoke detectors shall be UL 268 listed and FM approved.

8. All smoke detectors shall be field checked and set to meet the prevailing conditions of the premise and any Owner requests. All such work shall be performed by an authorized representative of the manufacturer trained in such procedures.

9. Photo-obscuration type smoke detection shall be used for smoke detection unless indicated otherwise indicated.

C. Heat Detector:

1. The heat detector shall be a thermal sensor and shall constantly monitor the space temperature and constantly report this to the system. The unit shall be analog addressable.

2. The sensor shall use dual solid state thermistors and shall monitor the ambient temperature from 32 degrees F, to 155 degrees F and provide a fast response to rapid increase in temperature. The sensor shall send data to the FACP representing the analog value of the ambient temperature. The FACP shall be suitable to monitor for set temperature (selectable by detector for 135 or 155 degrees F) and rate of rise (selectable by detector for 15 or 20 degrees F per minute). Individual detector thermal settings shall be adjusted for the building/space characteristics and operation but shall initially be set to 135 degrees F set temperature and 15 degrees F per minute rate of rise.

3. Detectors shall be designed for twistlock mounting to a separate base assembly. Provide back box suitable for surface mounting where required.

4. The detector base shall have terminals for making all connections; no soldering shall be required. It shall be possible to secure the detector in the base with a concealed socket headscrew to prevent unauthorized tampering.

5. Smoke detectors shall be UL 268 listed and FM approved.

6. All thermal sensors shall be field checked and set to meet the prevailing conditions of the premise. All such work shall be performed by an authorized representative of the manufacturer trained in such procedures.

D. Single Station Smoke Detector:

1. Detectors shall operate on the photoelectronic principle. Upon activation, the detector shall sound its integral alarm horn in accordance with ANSI S34.1 and operate its associated alarm circuit and illuminate the built-in alarm light. Integral alarm horn shall be rated 90 dB at 10 ft. Built-in alarm light shall be 177 candela, 60 flashes/minute strobe. Provide LED power-on/alarm indicator. Detectors shall operate on 120 volts AC. Provide an integral 9 VDC battery backup with low/missing battery alarm signal. Provide with 9 VDC long life battery. Provide backbox suitable for surface mounting where required. unit shall have single pole double throw dry contacts rated 1 amp resistive at 24 VDC. Contacts shall operate when the detector is in the alarm condition. Detector shall be U.L. listed and F.M. approved. Detector shall operate from 40°F to 120°F and up to 93% relative humidity. Provide tandem operation capability.

2. Interconnect all detectors inside a dwelling unit such that any detector in alarm will activate the notification appliances in all the other connected detectors.

3. Design Equipment: Gentex 7139CS C.

4. Make:

   a. Simplex

   b. Gentex

   c. Approved equal.

E. Addressable Initiation Module:

1. The addressable initiation module shall be used to connect supervised conventional initiating device or zone of supervised conventional initiating devices (water flow switches, tamper switches, manual pull stations, (4) wire smoke detectors, conventional (4) wire duct detectors, fire pump alarms, dry chemical fire extinguisher control panels, etc.) to one of the system's addressable circuits.

2. The module shall provide address setting means using rotary decimal switches and also store an internal identifying code which the control panel shall use to identify the type of device.

3. The module shall contain an integral LED that flashes each time the unit is polled.

F. Manual Pull Stations:

1. Noncoded pull-down type, double action (push then pull down) manual addressable units with front keyed test/reset. Units shall be semi-flush where installed in construction with hollow or block walls. Where construction does not allow semi-flush mounting then unit shall be surface mounted utilizing the manufacturers back box. Each unit shall have a distinct address. Units shall be key reset.

2. Units installed outdoors or in potentially wet locations shall be rated for such conditions.

3. Bright red finish with white lettering "FIRE ALARM".

G. Duct-Type Smoke Detector:

1. Detector shall be a photoelectric type that shall be activated by the presence of combustion products.

2. The detector head shall be a plug-in unit. The unit shall contain no moving parts. One chamber shall be for fire detection and the second chamber shall function as a reference, to stabilize the detector for changes in environmental temperature, humidity and pressure. It shall be possible to electrically check detectors sensitivity, using a sensitivity test set, or equivalent, and readjust the detectors sensitivity as required.

3. The detector base shall have terminals for making all connections; no soldering shall be required. It shall be possible to secure the detector in the base with a concealed socket-head screw to prevent unauthorized tampering.

4. Smoke detectors shall be listed by Underwriter's Laboratories, Inc. and approved by Factory Mutual Insurance Company.

5. Provide complete with sampling tubes. Size sampling tubes for 80% of the width of the duct. Locate in ductwork for the indicated system and in accordance with the manufacturer's recommendations. Unit shall be rated for air velocities of 300 to 4000 fpm as a minimum.

6. Provide addressable control module and 120V power for smoke damper operation.

7. Provide a remote indicating light/key test switch for each duct detector and mount in a local utility room with a sign indicating the system and location of the duct detector (i.e. AHU-2, Second Floor East End).

8. Provide addressable base.

H. Carbon Monoxide (CO) Detector:

1. Detector shall sense the level of CO concentration within a space and provide analog addressable signal to the system and be UL 2075 listed. Unit shall have a minimum life span of 10 years without replacement/recalibration.

2. Provide with audible notification base unit for local unique notification. Alarm and notification initiation shall be from the control panel.

3. Detector shall connect to the system addressable circuiting.

4. Alarm level shall be adjusted at the control panel. Upon an alarm the local notification shall sound and a trouble alarm initiated.

I. Single Station Carbon Monoxide (CO) Detector:

1. Detector shall sense the level of CO concentration within a space, provide local notification and be UL 2034 listed. Unit shall have a minimum life span of 10 years without replacement/recalibration.

2. Provide with audible notification base unit for local unique notification. Audible shall be 85dB minimum output at 10 ft.

3. Unit shall be 120V with 9V battery backup.

J. Single Station Combination Smoke/Carbon Monoxide Detector:

1. Detector shall be photoelectronic type and have carbon monoxide (CO) sensing. Upon activation, the detector shall sound its integral alarm horn in accordance with ANSI S34.1 and operate its associated alarm circuit and illuminate the built-

in alarm light. Integral alarm horn shall be rated 85 dB at 10 ft. Built-in alarm light shall be 177 candela, 60 flashes/minute strobe. Provide LED power-on/alarm indicator.

2. Detectors shall operate on 120 volts AC. Provide an integral 9 VDC battery backup with low/missing battery alarm signal. Provide backbox suitable for surface mounting where required. Unit shall have single pole double throw dry contacts rated 1 amp resistive at 24 VDC. Contacts shall operate when the detector is in the alarm condition. Detector shall be U.L. listed and F.M. approved. Detector shall operate from 40°F to 120°F and up to 93% relative humidity. Provide tandem operation capability.

3. Interconnect all detectors inside a dwelling unit such that any detector in alarm will activate the notification appliances in all the other connected detectors.

4. Design Equipment: Gentex 7139CS C.

2.6 NOTIFICATION APPLIANCES

A. Horns:

1. 24 volts DC.

2. Basic grille type with powder coated red finish paint.

3. Horn shall be rated 94 dBA (anechoic chamber) at 10 feet. Output shall be selectable steady tone or coded. Provide dampening devices to reduce unit output by 5dBA for a minimum of 40% of the system horn units and install as needed to meet the Owner's needs.

4. Units shall be semi-flush where installed in construction with hollow or block walls. Where construction does not allow semi-flush mounting then unit shall be surface mounted utilizing the manufacturers back box.

5. Units installed outdoors or in potentially wet locations shall be rated for such conditions.

6. Provide directional projector where noted on the Drawings.

7. Provide backbox and grille for fully recessed installations; 4 in. deep box maximum.

8. Sleeping locations shall utilize 520 Hz horns.

9. Horn for carbon monoxide alarm notification shall meet the requirements above but have a white finish color, have the word "ALERT" imprinted on the device and have a temporal Code 4 alarm.

B. Strobe Unit:

1. 24 volts DC with built-in Xenon Flasher; two watts maximum. Pulse duration shall be 0.2 seconds with maximum duty cycle of 40%. Illumination intensity shall be field selectable for 15/30/75/110 candela or 135/177/185 candela as applicable for the location. Output setting shall be 15 candela in corridors, 75 candela in general areas, 177 candela in sleeping areas or as indicated. Flash rate minimum 1 Hz, maximum 2 Hz. Units within building shall flash in synchronization.

2. Protruding pyramid shaped lexan lens with reflector and the word "FIRE" imprinted on the lens.

3. Rated life shall be a minimum of 500 hours of continuous operation.

4. Units installed outdoors or in potentially wet locations shall be rated for such conditions.

5. Units shall be semi-flush where installed in construction with hollow or block walls. Where construction does not allow semi-flush mounting then unit shall be surface mounted utilizing the manufacturers back box. Wall or ceiling mounted as noted on the Drawings.

6. Provide surface backbox for surface installation; 4 in. deep maximum.

7. Strobe for carbon monoxide alarm notification shall meet the requirements above but have a white finish color and have the word "ALERT" imprinted on the device.

C. Combination Horn-Strobe Units:

1. Unit shall be a combination of the horn and strobe units specified above in a single manufactured unit.

2.7 ADDRESSABLE CONTROL MODULE

A. The addressable control module shall have an individual system address, be supervised and control an output dry contact from indication from the FACP. This can be used to control or have an input to elevator controls, notification appliances, door holder circuits, fans systems, etc. as indicated. Modules shall be connected to the addressable loop(s).

B. The unit shall control an output relay (dry contact form C). The module shall mount in a 4 in. square, 2-1/8 in. deep electrical box.

C. The module shall contain an integral LED that shall flash each time the module is polled.

D. The module shall provide address setting means using rotary decimal switches and also store an internal identifying code which the control panel shall use to identify the type of device. Each unit shall have a separate address and be connected to the system addressable signaling circuit.

2.8 REMOTE ANNUNCIATOR

A. Wall mount within a flush box. Maximum depth of 4 in., stainless steel trim. Nominal dimensions of 4 in. x 12 in.

B. Annunciation shall be by two line by 40 character LCD display to provide system information and alarm/trouble description.

C. Unit power and control shall be from the FACP. Unit circuiting shall be supervised.

D. Provide trouble signal with audible buzzer, silencing switch and system reset. All pushbuttons shall be inoperable without keyswitch activated. Pushbuttons for alarm acknowledge, silence and alarm reset shall be standard on the front with a description. Shall include a minimum of four auxiliary switches/pushbuttons to be programmed as coordinated with the owner (possible options are door holder release override, manual alarm initiation, elevator capture bypass, etc.).

E. Tamper-resistant front panel screws.

2.9 MAGNETIC DOOR HOLDERS

A. Rated 115 volts AC.

B. Holders shall be wall or floor mounted adjacent to the doors as dictated by the building conditions. Floor mounted units shall only be used where wall mounted are not possible.

C. Door holders shall be aluminum construction, have 25 pound holding force and shall have all necessary mounting hardware. Provide door plate for each and extender chain (chromed and 1 in. links) where needed.

D. At each door holder location (or pair of door holders where two doors occupy the same opening), provide a flush mounted keyswitch to disable or enable the door holders. (Keyswitches not indicated on drawings). The keyswitch shall be maintained contact, with key removable in the vertical position. Keyswitch shall be tamper resistant, factory prewired brushed stainless steel finish. Provide all wiring to connect to local door holders. Make: DynaLock 2800 Series to meet the conditions or equivalent.

2.10 MUNICIPAL TIE EQUIPMENT - LEASED TELEPHONE LINE SYSTEM

A. Provide complete system consisting of sending and receiving equipment.

B. Transmission shall be provided over telephone lines arranged by the Owner.

C. Sending reversing relay and associated equipment shall be contained within the Fire Alarm Central Processing Unit enclosure.

D. Sending equipment shall transmit telephone line trouble as well as fire alarm condition signal.

2.11 AUTOMATIC DIALER

A. Provide automatic tie to telephone line upon activation of the fire alarm system and transmission of prerecorded message. Provide two telephone lines from the building service individually routed to the FACP and terminated.

B. Ten minute digitally stored message capacity.

C. Provide automatic line seizure.

D. Provide automatic telephone dialing to a prearranged telephone line. System shall have standard pre-recorded message stored in the memory. Record and store custom message as indicated by the Owner or call station.

2.12 DIGITAL COMMUNICATOR

A. The digital fire communicator shall be installed in the FACP or mounted in a separate enclosure. The communicator shall be powered by 24 VDC from the FACP and shall report four (4) conditions - (2) alarm, (1) trouble and (1) supervisory. The unit shall have a built in auxiliary relay output which is programmable for alarm or trouble conditions, and shall be capable of sending a distinctive AC power failure report.

B. Install all wiring in accordance with manufacturer's recommendations. All wiring shall be completely tested as directed by the manufacturer, and a written test report submitted to them for approval. Their approval shall be obtained before connecting any devices. The system manufacturer, by their approval of the test report, shall assume all responsibility for all installed wiring.

C. The communicator shall have the following features: visual and audible trouble indications; supervised or unsupervised input channels, dual phone line interface with line seizure; local and remote programming and automatic 24-hour test.

D. The communicator shall be UL 864 listed and meet the requirements of NFPA 72 Chapter 4 for supervising station fire alarm systems.

2.13 CENTRAL STATION MONITORING

A. Make all arrangements for, and pay all costs for a UL listed central station monitoring service to monitor the fire alarm system through the digital communicator for a period of one (1) year.

2.14 BATTERY AND CHARGER

A. Standby power shall be provided through 24 volt DC battery and automatic charger.

B. Provide sealed lead-calcium batteries suitable for a minimum of 24 hours of battery standby. When the system is operating on the battery supply, a trouble condition shall be generated. When utility power is restored, the system shall revert back to 120 VAC supply without any operator action.

C. Provide cell reversal protection.

D. Battery life expectancy shall be ten (10) years minimum.

E. Charger shall be self-regulating, solid state, type, automatic with capability to fully charge the discharged battery within 48 hours.

F. Locate charger within the FACP enclosure. Locate batteries in FACP enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION, EQUIPMENT

A. All installations shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of Work. Fire alarm installation shall be directed by a person who possesses a state license for installation of fire alarm systems. All equipment and components shall be installed in accordance with the manufacturer's recommendations.

B. System junction boxes and surface mounted device boxes shall be painted red.

C. All notification circuits shall originate from the FACP. Signal expander units shall not be used.

D. Provide all wiring to sprinkler flow switches, pressure switches, and alarm check valves, installed by others. Maintain supervisory circuitry to the switches. Use liquidtight conduit for the last 2 ft. - 0 in. of raceway at the switch.

E. Provide all wiring to post indicator valves, OS&Y valves and dry pipe sprinkler system maintenance air pressure switches, provided by others. Wire into the supervisory alarm portion of the fire alarm system.

F. Provide all wiring to the smoke dampers installed by others. Provide an addressable control module for each. Wire to the damper junction box with flexible conduit and wire; provide box or boxes as required. Install according to NEC. Smoke dampers shall close when its associated smoke duct detector is in alarm, upon direction from the FACP or if the associated fan unit is not operating.

G. Provide all power supplies and wiring to smoke relief hatches and fire barriers provided by others. Smoke relief hatch or fire barrier shall operate only when its associated smoke detector is in alarm.

H. Provide all wiring to duct smoke detectors. Duct smoke detectors shall be mounted on the ventilating ductwork by others. All mounting arrangements, holes cut into ductwork, sealing of openings along with ceiling and access doors for the duct type detectors shall be provided by others. Provide duct detectors along with sampling tubes with end caps. Sequence smoke damper operation thirty seconds after its associated fan has been shut down.

I. Provide all wiring required for fan shutdown. Wire from the addressable control module for each fan to be shut down and provide wiring from the module to the fan control unit (starter, adjustable speed drive, etc.) Dry contact shall be wired ahead of all control

functions for starters. Provide intermediate relay for control circuits beyond the rating of the control module.

J. Coordinate the municipal tie with the local Fire Department and comply with Fire Department requirements and regulations. Coordinate leased telephone line tie with Owner and Telephone Company.

K. Install all door holders in accordance with installation detail on the drawings and coordinate with the General Construction trade. Connect door holders to nearest 120 volt corridor receptacle circuit.

L. Provide 120 volt AC supervisory relays in the Fire Alarm Control Panel enclosure for each magnetic door holder power circuit to insure their associated circuit breakers are in the "ON" position. In the event a circuit breaker is in the "OFF" position, its associated supervisory relay shall transmit a trouble signal.

M. All single-station smoke detectors shall be directly connected to the lighting circuit of the dwelling unit or sleeping room with no intervening wall switch. Cord-connected installation shall not be permitted.

N. Provide all elevator capture control wiring. Installation shall be in accordance with manufacturer's recommendations.

O. Elevator machine room and shaft heat detectors shall be mounted within two feet of the sprinkler head where applicable.

P. Detection and initiating equipment shall be listed by NRTL and approved by FM.

Q. All surface mounted devices shall be mounted on a special box furnished by fire alarm equipment manufacturer. Total assembly shall be secure, smooth contour and have no protrusions.

R. Where detectors are installed on wood or masonry surfaces, attach brackets directly to the surface with tamperproof fasteners. Where detectors are installed on suspended ceilings, provide additional supports in the ceiling, such as channel support system, angle iron or additional runner bars. Fasten the additional supports rigidly to the ceiling runner bar system. Attach bracket to the supports with tamperproof fasteners. Install metal spacers between the bracket and supports so that the ceiling tiles will not be a part of the support system.

S. Install wall mounted audio/visual signal devices at 80 in. AFF to center line. Where ceiling types are called for, verify ceiling type and mounting height in the field. Provide pendant-mounted devices as required for specified mounting height.

T. An auxiliary fire alarm relay used to control an emergency control device that provides control functions described in this specification shall be located within 3 ft. of the emergency control device and all wiring shall be supervised.

U. All smoke detectors shall be field checked and set to meet the prevailing conditions of the premise. All such Work shall be performed by an authorized representative of the manufacturer trained in such procedures.

V. Provide circuiting from all indicated motor controls for indication if not operational and close any associated smoke dampers.

W. Provide a weather proof combination horn/strobe unit to indicate fire protection system water flow located near the fire department connection at a location coordinated with the local fire marshal.

3.2 SYSTEM CIRCUITING

A. All wiring shall conform to the NEC and to NFPA-72, National Fire Alarm Code.

B. Install all wiring in accordance with manufacturer's recommendations taking into account loading, intended location, circuit length, spare capacity and voltage drop.

C. All wiring shall be copper and installed in a dedicated/segregated EMT conduit system.

D. Power circuits:

1. Provide the required quantity of 20 ampere, 120 volt circuits to the system with a minimum of one (1) for the FACP**.**

2. Circuit breakers serving fire alarm system equipment shall have a red handle lock to prevent from manual off operation. Directory shall be marked for the specific equipment served.

E. Provide minimum #18 AWG twisted shielded pair for addressable signal line circuits. Notification appliance circuits shall be#14AWG minimum.

F. Addressable signal line circuits shall be NFPA 72 - 2010 Class A (redundant, single open operation).

G. Notification appliance circuits shall be NFPA 72 - 2010 Class A (redundant, single open operation).

H. Notification circuits shall be segregated as indicated on the drawings and by individual floors as a minimum.

3.3 PROGRAMMING

A. Include in bid the cost to cover all system programming, including items particular to this project (such as custom zone descriptions, time delay settings, sensitivity settings, etc.) such that entire system is 100% complete and operating to the Owner's satisfaction. Coordinate all system programming with the Owner. Also, provide programming of the system a minimum of once during the warranty period to provide changes requested by the Owner.

3.4 SPARE EQUIPMENT

A. Provide the following spare equipment to the Owner. Deliver the equipment to the Owner designated location on the project site in original packaging.

B. Equipment to include:

1. Smoke detectors: 5% of each type used with a minimum of five (5).

2. Heat detectors: 5% of each type used with a minimum of five (5).

3. Addressable control modules: 2% of each type used with a minimum of two (2).

3.5 TESTING AND INSTRUCTION

A. The complete fire alarm system shall be fully tested after the installation is complete. Testing shall include all devices, FACP, annunciator panel, other panels, features and functions. Testing shall be witnessed by the owners representative and be in accordance with the NFPA and herein. Provide a testing report to the authority having jurisdiction and the Engineer as a submittal.

B. Provide a minimum of four (4) hours of instruction to the operating personnel designated by the Owner's Representative with regard to use and operation of the system. Provide up to three programming modifications.

C. Provide three (3) sets of keys to all panels, manual stations, etc., to the Owner's Representative.

D. Provide a copy of the system programming to the Owner on a CD/DVD disk or flash drive.

E. Provide to the Owner system Operation Manuals as specified, that shall include as a minimum:

1. Bill of Material.

2. Catalog descriptive literature for all equipment. This shall include a description of the unit, ratings, functions, capability, materials and compatibility with other components.

3. Riser Wiring Diagram showing all equipment, devices, device addresses, connections, control connections, remote notification connection(s), wire quantities and sizes.

4. Floor plan indicating equipment and device locations, addresses, power circuit information with power panel location, notification circuiting, initiation circuiting and control circuiting. Contact the Engineer for a copy of the project floor plans.

5. Typical Terminal Wiring Diagram for each type of device.

6. Terminal wiring Diagram for all Fire Alarm equipment.

7. Calculations including:

a. Battery sizing calculations indicating total number of power devices, load associated with each type device and recommended battery capacity (AH).

b. Voltage drop calculations with actual equipment loads used to derive battery back-up ampere-hour rating and individual circuit voltage drop (indicate the wire size to be used and the associated voltage drop with the allowed voltage drop) for each circuit.

8. Instruction report starting when instruction was given and who was in attendance, signed by Owner's Representative.

9. A written test report from an authorized representative of the equipment manufacturer that each device and overall system operation has been 100% tested and approved.

10. Certificate of Completion as described in NFPA-72.

11. A two (2) year warranty in accordance with the Basic Requirements of these Specifications shall be provided for this system.

3.6 CO DETECTOR SIGNAGE

A. Coordinate with the Owner, install a permanent 8-1/2 in. and 11 in., two (2) color lamicoid sign at eye level in the vicinity of every CO alarm notification device indicating specific instructions to be followed, ex. "Do not enter room if an alarm is sounding".

END OF SECTION

APPENDIX A
FIRE ALARM SYSTEM OPERATION/SEQUENCE MATRIX

System Outputs

System Inputs	**Actuate Common Alarm Signal Indictor**	**Actuate Audible Alarm Signal**	**Actuate Common Supervisory Signal Indicator**	**Activate Audible Supervisory Signal**	**Actuate Common Trouble Signal Indicator**	**Activate Audible Trouble Signal**	**Indicate Zone or Device Description**	**Activate Notification Appliances**	**Display Change of Status on All Annunciators/Printers**	**Transmit Alarm Signal to Central Station**	**Transmit Supervisory Signal to Central Station**	**Transmit Trouble Signal to Central Station**	**Release Magnetically Held Doors**	**Recall Elevator to Recall Floor**	**Actuate Warning to Elevator Controls**	**Actuate Warning to Elevator Cabs**	**Activate Elevators Shunt Trip**	**Close All Related Smoke Dampers**	**Unlock All Exits and Control Doors**	**Shutdown Respective Air Handling Units (SA and RA)**	**Activate Floor Pressurization (High Rise Only)**	**Activate Stairwell Pressurization (High Rise Only)**	**Active Smoke Exhaust (High Rise Only)**	**Open Associated Smoke Hatch**	**Local Notification**
Fire Alarm System AC Power Failure					X	X						X													
Fire Alarm System Low Battery					X	X						X													
Open Circuit					X	X						X													
Ground Fault					X	X						X													
Circuit Short					X	X						X													
Manual Pull Station Actuation	X	X					X	X	X	X			X						X						
Area Smoke Detectors	X	X					X	X	X	X			X	X				X	X		X	X	X		
HVAC Air Duct Smoke Detector	X	X					X		X	X								X		X					
Area Heat Detectors	X	X					X	X	X	X			X	X				X	X		X	X	X		
Fire Suppression System Alarm	X	X					X	X	X	X			X	X				X	X						
Sprinkler Tamper Switch			X	X			X				X														
Fire Suppression System Alarm	X	X					X	X	X	X			X	X				X	X						
Sprinkler Tamper Switch			X	X			X				X														
Sprinkler Water Flow in Building	X	X					X			X			X	X				X	X						
Sprinkler Water Flow in Elevator Equipment Room or Shaft	X	X					X	X	X	X					X	X	X	X							
Elevator Shaft Smoke Detector	X	X					X	X	X	X														X	
Elevator Equipment Room Area Smoke Detector	X	X					X	X	X	X			X	X		X		X	X						
Elevator Shaft and Equipment Room Heat Detectors	X	X	X	X			X	X	X	X			X	X		X	X	X	X						
Elevator Pit Sprinkler Flow	X	X					X			X				X	X	X	X								
Elevator Pit Heat Detector	X	X					X	X		X				X	X	X	X								
Elevator Lobby Smoke Detectors	X	X					X	X	X	X			X	X				X	X		X	X	X		
Elevator Lobby Recall Floor	X	X					X	X	X	X			X	X				X	X		X	X	X		
Fire Pump Power Failure/Phase Reversal			X	X			X		X	X	X	X													
Fire Pump Low Fuel			X	X			X		X	X	X		X	X				X	X						
Fire Pump Running	X	X					X		X	X			X	X				X	X						
Jockey Pump Running			X	X			X		X		X														
Fire Pump not in Automatic Mode	X	X					X			X															
Area of Refuge Two-Way Communication Status	X	X					X			X															
Smoke Detector Adjacent to Smoke Hatch	X	X					X	X	X	X			X	X					X					X	
AHU Off, Any Reason																		X							
CO Detection			X	X			X		X		X														X