BEACON POINT DEVELOPMENT

Self-Help Ventures Fund and its Assigns

Raleigh, North Carolina
Main Building Tenant Suite Improvements

- **Tenant Suite 201 NC Legal Aid**
- **Tenant Suite 208 NC Legal Aid Innovation Lab**

May 16, 2024

PROJECT MANUAL

DTW Project No. 20015
Copyright © 2024

DTW ARCHITECTS & PLANNERS, LTD.

3333 Durham-Chapel Hill Blvd, Suite D-100 • Durham, NC • 27707 • 919.317.4020 • DTWArch.com

PROJECT: **BEACON POINT DEVELOPMENT**

Self-Help Ventures Fund and its Assigns
Tenant Suite Improvements Main Building
- Suite 209 – NC Legal Aid
Raleigh, North Carolina

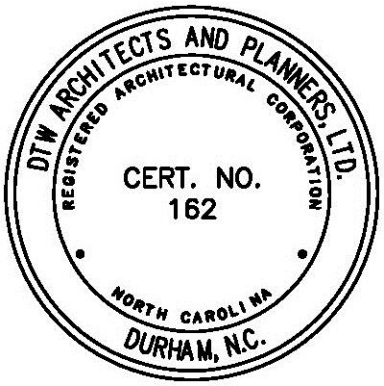
PROJECT REPRESENTATIVES:.....

OWNER REPRESENTATIVES:...Dustin Rawlings.....919.671.9110..
Phone

GENERAL.....TBD……Phone.....
Project Manager.....FAX:.....
Superintendent.....Job Phone:.....

			FAX
ARCHITECTS:	DTW Architects & Planners, Ltd.	919.317.4020	919.317.4023
PLUMBING:	Edmondson Engineers, P.A.	919.544.1936	919.544.2540
ELECTRICAL:	Edmondson Engineers, P.A.	919.544.1936	919.544.2540
MECHANICAL:	Edmondson Engineers, P.A.	919.544.1936	919.544.2540

SEALS:



PROJECT: **BEACON POINT DEVELOPMENT**
MAIN BUILDING TENANT SUITE IMPROVEMENTS
- Suite 209 – NC Legal Aid
Self-Help Ventures Fund and its Assigns
Raleigh, North Carolina

TABLE OF CONTENTS

AIA® Document A201® – 2017

General Conditions of the Contract for Construction

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

THE OWNER:
(Name, legal status and address)

THE ARCHITECT:
(Name, legal status and address)

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.

Sample

TABLE OF ARTICLES

Init.

/

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

INDEX
(Topics and numbers in bold are Section headings.)

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

.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.

Init.
/
AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

§ 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

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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:

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

.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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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.

Init.
/

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

§ 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

Init.

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

§ 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

SAMPLE

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

§ 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.

Init.
/

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

§ 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.

Draft

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

§ 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

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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.

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

§ 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

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

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.

Sample

AIA Document A201® – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017 by The American Institute of Architects. All rights reserved. The "American Institute of Architects," "AIA," the AIA Logo, "A201," and "AIA Contract Documents" are registered trademarks and may not be used without permission. To report copyright violations, e-mail copyright@aia.org.

Beacon Point Development
1425 Promise Beacon Circle, Raleigh NC.
Self-Help Ventures Fund
May 16, 2024

Shell Tenant Suite Improvements
Tenant Suite 201 - NC Legal Aid
Tenant Suite 208 - NC Legal Aid Innovation Lab

Project Team
Self – Help
Project manager – Dustin Rawlings
Dustin.rawlings@self-help.org / 919-671-9110
DTW Architects
Project Architect – Robert Sotolongo
rsotolongo@dtwarch.com / 919-697-7816
Project Manager – Susan Straw
sstraw@dtwarch.com / 919-317-4020
Edmondson Engineers
Project Engineer – Charles Crowl
charles@edmpa.com / 919-544-1936
Project Manager – Miles Smith
miles@edmpa.com / 919-544-1936
JD Sprinkler
Farrin Dunn – Project Manager
farrin@jdsprinkler.com / 919-553-2356

Federal Funding & Requirements
The Legal Aid suites at Beacon Point will be partially supported by federal funds from the American Rescue Plan Act of 2021 (ARPA) as a subaward (subrecipient) from the City of Raleigh (acting as a pass-through entity), and thus needs to follow the below provisions and procedures. Prospective contractors must comply with all applicable local, state, and federal laws, regulations, executive orders, and terms and conditions of the funding of the bid award. Funding is contingent upon this compliance.

The following federal provisions apply according to 2 C.F.R. § 200.326, 2 C.F.R. Part 200, Appendix II (as applicable), and other applicable laws:

1) Equal Employment Opportunity (41 C.F.R. Part 60);
2) Davis-Bacon Act (40 U.S.C. 3141-3148);
3) Copeland “Anti-Kickback” Act (40 U.S.C. 3145);
4) Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708);
5) Clean Air Act (42 U.S.C. 7401- 7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387);
6) Debarment and Suspension (Executive Orders 12549 and 12549)
7) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352);
8) Procurement of Recovered Materials (2 C.F.R. § 200.323);
9) Record Retention Requirements (See Award Terms and Conditions – Exhibit G and Compliance and Reporting Guidance);
10) Governmentwide Requirements for Drug-Free Workplace (31 CFR Part 20);

Bidding Schedule

Thursday May 16, 2024 – Public Advertisement of the bid on the State of North Carolina eVP (electronic vendor portal) public website - Drawings and Specifications available to bidders.
Tuesday May 28, 2024 – Onsite Prebid meeting at 1:30 pm at 1425 Promise Beacon Circle, Raleigh, NC 27610. Please meet at 1st floor lobby of the shell building.
Monday June 3rd, 2024 – Last day for questions from GC's
Wednesday June 11, 2024 – Sealed bids due at 3pm / sealed bids are to be delivered to the offices of DTW Architects, 3333 Durham Chapel Hill Blvd / Suite D100 / Durham, NC 27707
Sealed bids will be publicly opened starting shortly after 3pm at DTW Conference room.
Project award expected by late June.
Design Team + contractor to submit for Express permit review.
Self-Help and NC Legal Aid reserve the right to reject any or all bids for sound documented reasons.

General Contractor Bids

Bids shall include the following items.
Bids shall be Firm Fixed-Price (lump sum or unit price) as a Guaranteed Maximum Price for the construction scope shown on the drawings and specifications. The bid will be awarded to the responsible bidder whose bid, conforming with all the material terms and conditions of the invitation for bids, is the lowest in price.
Tentative schedule for the project.
Acknowledgement of addendums issued during the bid period from the design team.
Bidders must be properly licensed to perform this work as required under Chapter 87 of the General Statutes of North Carolina.
Please include information listed below for Owner contractor selection criteria.

- Firm fixed-price (lump sum or unit price) Basis Bid
- Completeness of the overall proposal
- Percentage of MBE and WBE subcontractors / please list percentages of each and good faith efforts to contact MBE and WBE subcontractors. The State HUB solicitation requirements of G.S. 43-128.2 will apply.
- Firm overall experience in this project type.
- Contractors proposed staffing for this project.
- Breakdown of bid proposal per CSI divisions especially for PME subcontractors.
- Proposed project construction schedule.
- Experience in City of Raleigh permitting and inspections process.
- The bidder must be properly licensed to perform this work and provide evidence of their license as required by NC G.S. 87-12.
- If the total bid price is greater than (>) $250,000, then a Bid bond/guarantee is required with the bid. (2 CFR 200.326)
    - After the award of the bid, a performance bond is required on the part of the awarded bidder/contractor for 100 percent of the contract price, and a payment bond is required on the part of the awarded bidder/contractor for 100 percent of the contract price.

Additional Items

JD Sprinkler will provide permit drawings for fire sprinkler work for each suite and contractors to contact JD Sprinkler for construction pricing to include on their bid proposal.

Self-Help will provide an emergency fire responder survey at the end of the project from Pinnacle Fire Systems who has surveyed the shell building and also provided the shell building fire alarm system.

Drawings and Specifications
Electronic PDF Drawings and specifications are available at this website, https://evp.nc.gov/ or by contacting DTW Architects.

Robert Sotolongo rsotolongo@dtwarch.com
Susan Straw sstraw@dtwarch.com

ARTICLE 16
AMENDED AND SUPPLEMENTARY CONDITIONS

AIA Document A201, General Conditions of the Contract for Construction - 2017 Edition, included herein as part of the Contract Documents, is hereby amended subject to modifications contained in these Amended and Supplementary Conditions. Where any part of the General Conditions is modified or voided by the Supplementary Conditions, the unaltered provisions shall remain in effect.

16.1 DELETE THE LAST SENTENCE OF PARAGRAPH 1.1.1 AND ADD
The Instructions to Bidders, Supplementary Instructions to Bidders, and Sample Forms contained in the Project Manual, shall become a part of the Contract Documents. The Advertisement for Bids and Bid Forms do not become a part of the Contract Documents.

16.2 The Contract: DELETE SUBPARAGRAPH 1.1.2 AND SUBSTITUTE
"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.

16.3 Paragraph 1.7: Digital Data Use and Transmission: ADD THE FOLLOWING:
"All transmissions of CAD or BIM files shall require written consent by the Architect and Design Consultants."

16.4 ADD TO THE END OF PARAGRAPH 2.1.1
Owner: SELF-HELP VENTURES FUND and its ASSIGNS
Owner Rep: ASPEN ROMEYN, ASSOCIATE PROJECT MANAGER
The Project Manager shall coordinate decisions and communications on behalf of the Owner. The Project Manager shall participate fully in Progress Meetings and Site Visits, and shall review and approve all Change Orders and Applications for Payment before processing.

16.5 ADD TO THE END OF PARAGRAPH 2.2.2
The required assessments for permanent changes in existing facilities and changed utility requirements may include but not be limited to: APPLICABLE IMPACT FEES & DEVELOPMENT FEES

16.6 ADD TO THE END OF PARAGRAPH 2.3.6
If inventory permits and with the Owner's approval, additional sets of Contract Documents will be furnished for use free of charge to the Prime Contractor upon submission of a written request. Otherwise, additional sets or partial sets may be obtained from the Architect for the direct cost of reproduction.

16.7 AMPLIFY PARAGRAPH 3.4.1
Temporary facilities and services shall include but not be limited to the following:

A. WATER

Water for construction use shall be provided by the Owner from a temporary restricted source as approved by the Owner. Hook-up of water services shall be provided and maintained by the General Contractor.

B. SANITARY FACILITIES

Sanitary facilities shall be provided by the Contractor. Location and type of units shall be subject to approval of Raleigh Inspections Dept. and Wake County Health Dept. and the Owner's Representative, Aspen Romeyn. All other sanitary facilities are to be considered "off limits" to contracted personnel.

C. ELECTRICAL POWER

The General Contractor will be responsible for setting up temporary power at the main construction area. Contractor shall bear all cost of hook-up, maintenance and disconnect of temporary service.

D. WORK LOCATION

The Contract Area Limits, as shown on the Site Drawing, represent the areas of confined construction activity. Storage of materials, staging, parking of personnel vehicles and other construction-related activities shall be restricted to these limits, except by permission of the Project Manager, Aspen Romeyn or required access to utilities. The Contractor shall supply a meeting room with a 3'x 8' table and (10) chairs for project meetings.

16.8 ADD TO THE END OF PARAGRAPH 3.6.

Contractor shall maintain records of all State, Local or Federal Taxes paid for materials equipment, rentals or contracted labor on this project. Contractor shall provide a list of all taxes paid with receipts to be attached to each application for payment submitted to the Owner.

16.9 ADD TO THE END OF PARAGRAPH 3.12.5

Submit all shop drawings electronically in PDF format that can be edited. Refer to the Technical Sections for required submission of samples and color charts; if number of copies is not specified, submit 3 copies.

16.10 ADD THE FOLLOWING AT THE END OF PARAGRAPH 3.12.8

"The Owner and the Architect will consider a formal request for the substitution of products in place of those specified if substitute product is submitted for evaluation ten (10) days prior to establishment of final contract price and the proposer of a substitution of change shall bear the expense of any changes made necessary to another Subcontract. The Owner's Project Manager reserves the right to acceptance or rejection of proposed substitutions. Upon acceptance of a proposed substitution, the Owner's Project Manager reserves the right to secure samples of the substitution and to submit them to an independent testing laboratory. If the results of the testing and evaluation do not meet or exceed the requirements of the specifications, the Architect, upon recommendation by the Owner's Project Manager, shall reject the substitution".

By making requests for substitutions based on Paragraph 3.12.8 above, the Contractor:

1. represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified.
2. represents that the Contractor will provide the same warranty for the substitution that the Contractor would for the specified.
3. certifies that the cost data presented is complete and includes all related costs under this Contract except the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently becomes apparent; and
4. will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

16.11 ADD TO THE END OF PARAGRAPH 3.13

The Contractor shall coordinate and conduct the construction operation with minimal inconvenience to the Owner, Adjacent Landowners and the Public with respect to vehicular access, noise, dust, mud, construction equipment and supplies, effects of inclement weather, and inconsiderate behavior by construction personnel. Pedestrian and vehicular circulation, permanent and temporary parking, and storage of materials and equipment are to be coordinated with the Project Manager, Aspen Romeyn.

16.12 ADDITIONAL CONDITIONS SHALL INCLUDE:

A. Normal working hours shall be confined to the period between 7:30 A.M. and 5:30 P.M. Monday through Saturday. Work may occur on Sunday only with permission from Owner.

B. No construction personnel are to be on any portion of the site other than the immediate construction area for any reason without permission of Self-Help's Project Manager, Aspen Romeyn. See Division 1 for additional requirements.

C. No construction personnel are to discuss any aspect of construction with any resident at any time. All construction personnel will please report to the Architect immediately if any resident is observed to be on the construction site or in a physically hazardous situation.

D. Parking and vehicle control is of critical importance; all such measures as called for in these specifications shall be strictly observed. See Section 015000, "Access Roads" and "Parking".

E. No firearms of any type will be allowed on site.

F. No illegal drugs, narcotics, or alcohol will be allowed in any construction area. Any observed erratic behavior resulting from off-site or on-site use of these substances shall be grounds for personal removal of such personnel from the construction site.

G. Owner reserves the right to require immediate removal of any person violating these rules.

H. The Contractor does hereby agree to indemnify Self-Help Ventures Funds and its Assigns for, and to hold Self-Help Ventures Funds and its Assigns harmless from, any and all liability, loss or damage, including reasonable attorneys fees, which may or might be incurred as a result of Self-Help Ventures Funds and its Assigns' exercise of the rights set forth herein.

I. Main access to the construction site shall be from Beacon Promise Circle Road. Self-Help Ventures Funds and its Assigns reserves the right to fine the Contractor $100.00 for each unapproved use of access of any other roads. Self-Help Ventures Funds and its Assigns shall also retain the option to have the party making such unapproved use removed from the grounds. The Contractor is responsible for informing all affected parties of access rules and to enforce their observance. Convenient access by residents and emergency personnel to main entrance, adjacent roads and parking areas, shall be maintained at all times in a safe, clean manner. Damage to Beacon Promise Circle Road caused by construction traffic shall be repaired in a timely manner as directed by Aspen Romeyn (Project Manager) by the Contractor prior to completion of the work based on unit contract prices included in Contract.

J. Parking: All construction personnel shall park in areas designated by the General Contractor. Self-Help Ventures Funds and its Assigns reserves the right to tow vehicles not parked in appropriate areas. Self-Help Ventures Funds and its Assigns reserves the right at any time to implement a vehicle permitting system for traffic and parking control. The Contractor shall cooperate fully and instruct his forces to cooperate fully with this system, if implemented.

K. All utility service tie-ins or interruptions to existing facilities must be approved by Aspen Romeyn with three (3) days notice required prior to commencement of any such work.

L. General Contractor shall implement and maintain worker badge identification system for all permanent and temporary workers with separate colors for each including worker name, picture, date issued and employer. Badges to be displayed at all times while on construction site and parking areas designated by the General Contractor. Any General Contractor worker, subcontractor or material delivery not wearing their badge on the construction site will be asked to leave the site immediately until a badge is obtained and displayed.

16.13 ADD TO THE END OF PARAGRAPH 4.1.1

Architect: DTW ARCHITECTS & PLANNERS LTD.
3333 DURHAM-CHAPEL HILL BLVD., SUITE D-100
DURHAM NC 27707

16.14 ADD TO THE END OF PARAGRAH 6.2.4

"The Contractor shall be responsible for trees, shrubs or other landscape elements that are in the tree protection area that are damaged by construction activity by the Contractor. The Landscape Architect and Owner will determine the monetary value of the damage caused by the Contractor.

16.15 Article 7.2 Change Orders: ADD THE FOLLOWING SUBPARAGRAPH 7.2.2

7.2.2: The allowance for the combined overhead and profit included in the total cost to the Owner shall be based on the following schedule:

1. For the Contractor, for any work performed by the Contractor's own forces, lump sum management fee of the cost.
2. For the Contractor, for work performed by his Subcontractor, lump sum of the amount due the Subcontractor.
3. For each Subcontractor or Sub-subcontractor involved, for any work performed by his own forces, 10 percent of the cost.
4. For each Subcontractor, for work performed by his Sub-subcontractors 5 percent of the amount due the Sub-subcontractor.
5. Cost to which overhead and profit or management fee is to be applied shall be determined in accordance with requirements of the General Conditions. Cost of job overhead shall include daily job cost without "home office' overhead.
6. In order to facilitate checking of quotations for extras or credits, all proposals, shall be submitted in the following manner. Change Order Requests failing to comply with this form will be returned for correction.

a. Materials
(itemized breakdown) $_____

b. *Rent of Equipment
(list separately) $_____

Sub-Total (1) $_____

c. Labor (itemized breakdown) $_____

Sub-Total (2) $_____

d. Management Fee
(when applicable, 6% x a, b, & c.
See 1 through 5 above.) $_____

Sub-Total (3) $_____

e. Insurance
(Workmen's Compensation, Social
Security or as otherwise required
and/or specified) $_____

Sub-Total (4) $_____

f. Guarantee Bond
(on Sub-Total 3 as applicable) $_____

TOTAL $_____

g. Copies of Labor, materials and subcontractors items relevant to Change Order shall be submitted with the Change Order $_____

*Rates not in excess of those prevailing in areas.
** If deductive changes, this figure to be 6%.

16.16 DELETE SUBPARAGRAPH 8.2.1 AND SUBSTITUTE:
"Time is of the essence on this Contract, and shall be a consideration in awarding the Contract. The time allocated for construction of the work covered by the base bid of this contract is to be **TBD (___) days (_____ Months)** from the time of Notice to Proceed if the building permits are issued by the Wake County / City of Raleigh. If the Contractor fails to complete the work within the maximum time, the Owner will incur substantial damages, including but not limited to capitalized interest payments in respect to those bonds that are to be used to finance the project and loss of revenue resulting from the inability to utilize the completed project. Liquidated damages for exceeding the designated period for construction shall be as specified below".

16.17 Delays and Extensions of Time: ADD THE FOLLOWING CLAUSES 8.3.1.1 THROUGH 8.3.1.4 TO SUBPARAGRAPH 8.3.1:
"8.3.1.1 If the progress or completion of the work be delayed by any fault, neglect, act or failure to act on the part of the Contractor or anyone acting for or on behalf of the Contractor, then the Contractor shall, in addition to all of the other obligations imposed by this Contract and by law upon the Contractor, and at no cost or expense to the Owner, work such overtime or require the appropriate subcontractor to work such overtime as may be necessary to make up for all time lost and to avoid delay in the progress and completion of the work".

"8.3.1.2 "The Contractor and Contractor's surety, if any, shall be liable for and shall pay the Owner the sums hereinafter stipulated as liquidated damages for each calendar day of delay, until the Work is substantially complete: **TBD ($_____)** for each day of the first sixty days of delay; **TBD ($_____)** for each day of delay over sixty days up to and including one hundred eighty days; and **TBD ($_____)** for each day of delay over one hundred eighty days".

"8.3.1.3 For the purposes of this Article, Subcontractors shall be deemed to be acting for and on behalf of the Contractor".

8.3.1.4 The time allocated by the Contractor for construction, as inserted in the space provided on the proposal form, should be calculated to include the following number of "rain" days by calendar month. Any request for an extension of the contract term due to inclement weather shall be considered only where the number of documented days with rainfall exceeding .10 inches is **greater** than the values noted for that month below. The extension, if granted, shall be the difference between documented and allocated (as below) "rain days".

January	7	July	7
February	7	August	6
March	7	September	5
April	6	October	5
May	7	November	5
June	6	December	6

16.18 MODIFY PARAGRAPH 9.2
CHANGE the 2nd line after Architect, to read, "within 30 days after Notice to Proceed, a schedule of values ...".

16.19 ADD SENTENCES TO 9.3.2
"Contractor shall include in an application all shipping tickets, tax receipts, packing list and the vendors invoice when billing in **monthly** cycles on-site stored materials. Insurance Certificate and above back-up information shall be included with application when billing for off-site stored materials. Off-site stored materials shall be verified by the Architect prior to approval.

16.20 DELETE SUBPARAGRAPH 9.3.3 AND SUBSTITUTE
"The Contractor warrants that title to all work will pass to the owner at the time the work is incorporated unless payment is made for materials or equipment before incorporation, such as when it is stored off the site or on the site. **The Contractor will warrant title to the Owner on all materials or equipment before incorporation if the Owner has paid for such items.** The Contractor further warrants that upon submittal of an Application for Payment of all work for which Certificates for Payment have been previously issued and payments received from the Owner shall be free and clear of liens, claims, security interest or encumbrances in favor or the Contractor, Subcontractors, materials suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the work".

16.21 ADD THE FOLLOWING CLAUSE 9.3.3.1 TO SUBPARAGRAPH 9.3.3:
"9.3.3.1 At the Owner's request the Contractor shall submit with the monthly application for payment, lien waivers from the Contractor, Subcontractors and material suppliers for the previous application period. Along with these lien waivers, the Contractor and Subcontractors shall submit a letter of certification stating the submitted lien waivers include all parties they have contracted/purchased good or services from the applicable period. If this documentation is not properly furnished with the application for payment the application will be returned without review".

16.22 ADD THE FOLLOWING SUBPARAGRAPH TO 9.8.1:
"Substantial completion is to be defined as acceptance for occupancy/licensure by Self-Help Ventures Funds and its Assigns and the Architect.

16.23 MODIFY PARAGRAPH 9.8.2
ADD to the end of the first sentence:
"... prior to final payment, including items identified by the local Inspections Office to be completed for a Certificate of Occupancy."

16.24 MODIFY PARAGRAPH 9.10.2
Five (5) copies of additional data under Item (5) to be submitted to the Architect and Owner shall include but not be limited to the following:

1. Material / Equipment Guarantees and Warranties
2. Instruction Manuals for Operation and Maintenance
3. As-Built Prints (1 set)
4. AIA G706A - Contractor's Affidavit of Release of Liens
5. Affidavit of No Asbestos-Containing Materials
6. Certificate of Occupancy (if required)

16.25 ADD TO PARAGRAPH 10.1
The Prime Contractor will comply with the Occupational Safety and Health Act of 1970 (OSHA), amended to include additional Federal and State regulations which have been enacted therewith, and shall require and be responsible for compliance by its agents, employees, suppliers, material men, assignees and subcontractors. The Prime Contractor shall be responsible for all citations, assessments, fines, penalties and delays in the performance of work on the project incurred by reason of failure or failure on the part of its agents, employees, suppliers, material men, assignees or subcontractors to so comply. The Prime Contractor shall comply with all applicable laws, ordinances, rules, regulations and lawful orders of public authority having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss.

16.26 Contractor's Liability Insurance: ADD A FINAL SENTENCE TO SUBPARAGRAPH 11.1.1:
"The Contractor shall purchase all such insurance from and maintain all such insurance in a company or companies carrying a Best & Co. rating of "A" or higher and lawfully authorized to do business in North Carolina".

16.27 DELETE SUBPARAGRAPH 11.1.2 AND SUBSTITUTE:
"Insurance referred by Subparagraph 11.1.1 shall be written for not less than the following limits of liability and shall include contractual liability insurance as applicable to the Contractor's obligations under Paragraph 3.18.

Provide Workmen's Compensation including Occupational Disease and Employer's Liability insurance as follows:

a. Statutory - Amounts and coverage in the manner and to the extent provided by the State of North Carolina.

b. Employer's Liability - At least $100,000 for each accident.

Provide Public Liability - including coverage for direct operations, sublet work, Contractual Liability and completed operations with limits not less than those stated below:

a. Bodily Injury Liability - including personal injuries
   $2,000,000 Each Person
   $2,000,000 Each Occurrence

b. Property Damage Liability
   $2,000,000 Each Occurrence
   $2,000,000 Aggregate

c. Regarding Completed Operations Liability - Continue coverage in force for one year after completion of work.

Comprehensive Automobile Liability Insurance including Coverage for Owned, Non-Owned, and Hired Vehicles - with limits not less than those stated below:

a. Bodily Injury Liability
   $2,000,000 Each Person

$2,000,000 Each Occurrence

b. Property Damage Liability

$2,000,000 Each Occurrence

Liability Insurance may be arranged by Comprehensive General Liability and Comprehensive Automobile Liability policies for the full limits required; or by a combination of underlying comprehensive liability policies for lesser limits with the remaining limits provided by an Excess or Umbrella Liability Policy.

16.28 ADD THE FOLLOWING SENTENCE TO SUBPARAGRAPH 11.1.4:
"Policy shall remain in effect non-cancellable until all Contract requirements are complete and the project accepted by the Owner. Policy may then be cancelled upon 30 days written notice by registered mail".

16.29 Add the following to modify Paragraph 11.4:

a. Contractor, upon award of Contract, shall furnish a Performance Bond and a Payment Bond executed by a surety company authorized to do business in North Carolina. The Bonds shall be in the full contract amount, and executed on the forms provided therefore.

b. All bonds shall be counter-signed by an authorized agent of the Bonding Company who is licensed to do business in North Carolina.

c. The Contractor shall deliver the required bonds to the Owner not later than the date of execution of the Contract, or if the work is to commence prior thereto in response to a letter of intent, the Contractor shall, prior to commencement of the work, submit evidence satisfactory to the Owner that such Bonds shall be furnished.

16.30 Tests and Inspections: DELETE THE FOLLOWING PHRASE IN SUBPARAGRAPH 13.4.1:
"... and shall bear all related costs of tests, inspections and approvals".
DELETE THE FINAL SENTENCE OF THE SUBPARAGRAPH 13.4.1 AND SUBSTITUTE:
"The Owner shall bear all costs of tests, inspections and approvals".

END OF AMENDED & SUPPLEMENTARY CONDITIONS

DIVISION 1

GENERAL REQUIREMENTS

SECTION 011100: SUMMARY OF WORK

PART 1: GENERAL

This project consists of Tenant Suite Improvements (NC Legal Aid) at the main building at the Development of Beacon Point located at the corner of Beacon Ridge Road and Rock Quarry Road in Raleigh, North Carolina. Scope of work includes general construction, mechanical, electrical and plumbing.

See schedule and contract document drawings for description of scope of work at each tenant suite. Note each tenant suite will require its own building permit.

PART 2: CONTRACTS

The method of contracting for this project shall be based upon the current North Carolina Bid Laws as amended for awarding contracts.

2-01: SINGLE PRIME CONTRACT

Work on this project shall be awarded as a Single Contract to a General Contractor (Prime Contractor). See Supplementary Conditions and Technical Sections for permit and fee requirements. The proposed contract form will be AIA Document A102-2017 – Standard Form of Agreement Between Owner and Contractor.

PART 3: WORK BY OTHERS

3-01: Work by Owner: Testing Services, Security system, IT wiring, Furniture and work stations as shown on furniture drawings, Moveable wall system, and TV monitors.

END OF SECTION

SECTION 012100: ALLOWANCES

PART 1: GENERAL

Allowances are subject to the requirements of the General Conditions of the Contract. Note identified allowances shall be included in Base Bid for Single Prime Bid.

PART 2: CASH ALLOWANCE

2-01: General Contract:

A) FINISH HARDWARE - See Section 087000.
Allowance Amount = $31,000.00 at Suite 201 +208 NC Legal Aid

END OF SECTION

SECTION 013113: PROJECT MEETINGS

PART 1: GENERAL

Informal progress meetings shall be held with the Prime Contractor's site representative every two weeks and Monthly Formal Construction Progress meetings will be held for the duration of the project as described below.

PART 2: MEETINGS

2-01: Construction Progress Meetings

Formal Construction Progress Meetings shall be held every other week and attended by the General Contractor and Subcontractors performing current work. The Architect shall be responsible for conducting this meeting and the General Contractor shall be responsible for reporting on their progress of the work.
Informal meetings shall be held once a week if formal meeting are not being held that week.

2-02: Progress Schedule

The General Contractor shall be responsible at each meeting to report on the overall progress of the work; see Section 013200 and General Conditions for requirements. All Project Contractors shall coordinate their activity start dates with the General Contractor prior to each meeting.

END OF SECTION

SECTION 013200: CONSTRUCTION SCHEDULE

PART 1: GENERAL

1-01: Work Included: This sections includes the labor and related services necessary to develop, report and update project scheduling as proposed herein.

1-02: Objectives: The primary objective of the construction schedule is to insure the adequate planning, scheduling and execution of the construction activities so that they proceed in an orderly manner within the Contract Time.

1-03: Services: The General Contractor, in collaboration with the other Prime Contractors, shall provide the services of a scheduling program which shall display graphically the controls necessary to reflect the Prime Contractor's actual construction plan. This program shall provide the basis for monitoring the individual progress of each Prime Contractor relative to each other, to detect problems early in order to institute corrective actions, and to be a mechanism for monitoring such corrective actions.

1-04: Pre-Bid Conference: The General Contractor and each Prime Contractor shall review and analyze the proposed Start/Completion Dates, determine the feasibility of activity duration and sequences as outlined, and access the interface requirements as they relate to the Prime Contract. Discussion of problems, conflicts, or alternative approaches will be a primary agenda item regarding any changes in the dates or sequence of the work.

1-05: Notice To Proceed: Following the Notice to Proceed and in accordance with the General and Supplementary Conditions, the Prime Contractor shall submit within 15 days of Notice to Proceed, to the Owner and A/E a preliminary schedule, in precedence format, for the scope of construction/renovation work. The preliminary schedule shall reflect proposed activity duration of the Prime Contractor, proposed testing and inspection duration, proposed occupancy dates based on separate permits, and proposed punch list duration; the duration shown shall be given in calendar days and shall extend no later than the project's required completion date.

PART 2: PRODUCTS

2-01: Schedule Distribution

Following a review and correction process by all parties, the Prime Contractor shall distribute copies of the completed schedule electronically.

2-02: Start/Completion Dates

The Owner and A/E make no warranty, either express or implied, as to the reasonableness or feasibility of the following time required to complete the work.

Anticipated construction schedule is as follows:

COMMENCEMENT OF CONTRACT .....**Upon Owner's Notice to Proceed**

Notice to Proceed (Target Date)	TBD
Substantial Completion (Contractor to provide Schedule)	TBD
Final Completion	TBD

SUBSTANTIAL COMPLETION (Issuance of Certificate of Occupancy).....**TBD Calendar Days (__ Months) from NTP**

FINAL COMPLETION OF OWNER/ ARCHITECT PUNCHLIST.....**30 Calendar Days from SC**

2-03: Construction Progress Schedule

The schedule shall be a diagram designed to illustrate the following:

a) The order and inter dependencies of the Prime Contractors' activities and the major points of interface, including specified points of inspection and occupancy dates based on separate permits as outlined above.

b) General sequence of operations of the work with time limits specified as "Early/Late Start", "Early/Late Finish", "Actual Start/Finish" and "Float Time".

c) Work to be started and completed by the Owner or Separate Contractors.

2-04: Schedule Maintenance: The Prime Contractor shall have control of and maintain the overall Project Schedule as update information is submitted from the other Subcontractors. Once a month at one of the Construction Progress Meetings, the Prime Contractor shall submit updated progress data consisting of:

a) Actual start dates of activities in process.
b) Estimated duration of activities in process.
c) Actual finish dates of activities completed.
d) Actual or anticipated deviations from the schedule.
e) Solutions for alleviating the effects of deviations.

At approximately 50% completion of the Work, the Prime Contractor shall again distribute copies of the computerized schedule diagram, accurately reflecting the current progress of the work, to all parties who received the initial diagram.

PART 3: EXECUTION

3-01: Schedule Alteration: The intent of this section is to set forth the required completion dates of the work and to which the Prime Contractor is required to adhere. In the event that the Prime Contractor desires to change their plan of construction, the proposed change must be submitted to the Owner and A/E for review. The changes must be accompanied by a written description of the reasons for changing, and method of maintaining adherence to activity duration already in process and the impact of the rescheduling. No schedule alteration shall be undertaken by the Prime Contractor unless approval in writing is issued by the Owner. The Prime Contractor shall issue revised data, following approval from the Owner, at the next regularly scheduled progress meeting.

3-02: Extensions of Time: If the Prime Contractor or Sub-Contractor requests an extension of time as a part of a change request in the contract, he shall submit a written statement as described in the paragraph above. Any request for time extension shall include a schedule impact narrative and "fragnet" of activities detailing which activities are affected by the change and to what degree.

The time extension request shall be forwarded to the Prime Contractor for schedule forecasting predicting the actual Project Completion Dates.

Extensions of time shall be considered as required by the General and Supplementary Conditions and compliance with these specifications; the Owner shall not be held responsible or liable to the Prime Contractor for any schedule deviation due to failure of the Owner to grant time extensions under the Contract Documents should the Prime Contractor fail to substantially comply with the submission and justification requirements as described above. The Prime Contractor's failure to perform in accordance with the Construction Schedule shall not be excused, nor be chargeable to the Owner, because the Prime Contractor has submitted time extension requests.

3-03: Coordination: Prime Contractor shall coordinate his work fully with that of the other Sub-Contractors and shall cooperate fully with the Owner and A/E in maintaining orderly progress toward completion of the work as scheduled. The Owner shall be responsible for keeping the Prime Contractor fully aware of schedules for Work by Subcontractors (e.g. asbestos removal) and delivery dates for Owner-furnished equipment to be installed by Prime Contractor and delivery dates of movable equipment to be stored in the building. Failure of such equipment to arrive on schedule shall not be justification for an adjustment to the contract time. Failure of subcontractors to meet their schedules shall be considered cause for an extension of time only if the delay is considered by the Owner and A/E as unreasonable in its direct impact on the progress of the work, in accordance with the requirements of the Contract.

3-04: Float Time: Float Time is defined as the amount of time between the earliest start date and the latest start date or between the earliest finish date and the latest finish date in a chain of construction activity duration. Float Time is not for the exclusive use of benefit of the Prime Contractor or the Owner. It shall be assumed that the progress of the work shall proceed according to the early start dates; apportionment of float time by the Prime Contractor shall be reviewed by the Owner and A/E in accordance with the needs of the project. The Prime Contractor acknowledges that any delays affecting paths of activities containing float time, will not have any affect upon the Start/Completion Dates, provided that the actual delay does not exceed the float time associated with these activities.

3-05: Contractors Guarantees

Prime Contractor guarantees that he will not:

a) Misrepresent to the Owner the planning, scheduling or execution of the work.

b) Prepare schedules, updates, revisions or reports for the work which do not accurately reflect the intent of the Prime Contractor as to:

1) Sequences of activities.
2) Duration of activities.
3) Responsibility of activities.
4) Resources availability.
5) Labor availability or efficiency.
6) Completion of any item of work or activity.
7) Completion dates.
8) Delays or problems encountered or expected.
9) Subcontractor delay claims.
10) If applicable, the float time available.

END OF SECTION

SECTION 013223: FIELD ENGINEERING

PART 1: GENERAL

1-01: Work Included: This section includes the labor, materials, equipment and related services necessary to perform site survey and building and site layout work as shown on drawings and specified herein. Required roof testing is included in this Section.

1-02: Standards: Except as modified by governing codes and these specifications, survey and testing crews shall comply with all applicable provisions and recommendations of ANSI A10.2, Safety Code for Building Construction and OSHA.

1-03: Certification & Testing

1) The Prime Contractor shall provide the services of a Professional Surveyor, registered by the State of North Carolina, experienced in and equipped for large-scale site engineering.

2) Manufacturer of roof system Representative shall certify that the system is in compliance with system specified and warranty requirements.

1-04: Submittals-Survey: Prior to laying out the work, the Prime Contractor and Surveyor shall review the Contract Documents Site Plans for discrepancies or conflicts with actual field conditions. Note all errors or discrepancies requiring clarification shall require the Prime Contractor to inform the Architect and Civil Engineer immediately. If requested by the A/E, submit for review a revised drawing showing initial corrections to the Contract Documents.

1-05: Record Drawings: Maintain a set of record drawings with survey data, elevations, field dimensions and notes regarding changes or adjustments to the Contract Drawings. Verify locations of all work being installed underground by the Subcontractors (M/E/P) and storm drainage lines. The Prime Contractor shall be responsible for maintaining and updating these record drawings for inclusion in the Project Closeout Document submission to the Architect. Utility survey shall meet the requirements of the City/County Inspections and planning departments for as-built closeout documents and shall be sealed by the registered surveyor.

PART 2: SURVEY WORK

2-01: Property Lines: Verify and establish location of current property corners, current easements, any proposed roadway widening easements and setbacks.

2-02: Coordination: Contractor shall coordinate with ULOCO or NO CUTS for charting underground utilities. Coordinate underground routing with Contract Documents and proposed layout of the work.

2-03: Staking: Install all reference point markers for laying out the work using standard engineering stakes. Differentiate point markers with different colors of ribbon. Label grade stakes with elevations referenced to corrected contract drawings.

2-04: Reference Lines: Install reference lines using point markers as described above. Leave all stakes secure and in proper position for laying out of the work by all Prime Contractors.

PART 3: EXECUTION

3-01: Protection: The Prime Contractor shall be responsible for maintaining Reference Lines and Reference Points in secure and proper position. Should any points be disturbed by the acts of the Prime Contractor or their Subcontractors, they shall collectively instruct the surveyor to reestablish the disturbed points, at no cost to the Owner.

3-02: Clearly delineate and protect benchmark around the site for permanent reference use.

END OF SECTION

SECTION 014100: REGULATORY REQUIREMENTS

PART 1: GENERAL

In addition to regulatory requirements of governing authorities, codes, ordinances, industry requirements and association requirements noted in or reasonably implied from these specifications, the following shall become a part of the Contract Documents:

A) North Carolina State Building Code - Vol. I, Latest Edition.
B) City of Raleigh Zoning Ordinance - Latest Edition.
C) UL fire Resistance Rating - Latest Edition.
D) FM Engineering Corporation - Latest Edition.
E) NFPA 101 Life Safety Standards - Latest Edition.

PART 2: SPECIFIC REFERENCES

2-01: NFPA 101: Provide exterior sign at the primary entrance to the facility indicating the street address. Sign must be clearly visible from a vehicle on the street.

2-02: Fire Lanes and Public Roadway access to the existing site buildings and temporary parking areas shall be clearly marked and maintained during the construction period by the Contractor. All access shall be approved by the Wake County Fire Marshal's Office.

2-03: NCSBC - Chapter 6, 702.1.6: Corridor partitions, smoke-stop partitions, horizontal exit partitions, exit enclosures, and fire walls shall be effectively and permanently identified with signs or stenciling in a manner acceptable to the local building authority. Identification shall be located above any decorative ceiling and in concealed spaces.

2-04: NCSBC - Chapter 6 and NFPA 101: Smoke doors in Corridor shall have a permanently installed sign mounted on the face of each door in the open position. Suggested wording shall read:

"IN CASE OF FIRE, SMOKE DOORS WILL CLOSE AUTOMATICALLY.
DO NOT BLOCK".

2-05: All required **egress windows** units required for secondary exit, shall have a sign reading "Emergency Exit Window" attached to fixed framing of windows.

END OF SECTION

SECTION 014500: QUALITY CONTROL

PART 1: GENERAL It shall be the responsibility of the General Contractor to schedule periodic meetings between the subcontractors, suppliers, foremen, inspectors and other parties involved with the daily progress of the work. Cooperation among all parties is expected for timely completion of the project.

PART 2: CRITICAL EVENTS The General Contractor shall exercise control over the project regarding events such as site demolition, steel erection and installation of Equipment, during which no other activity can take place in a given area. For areas to be inspected and covered up, 48-hour notice must be given to Local Inspectors and A/E.

PART 3: COOPERATIVE ARRANGEMENTS

A) **Safety:** Because of the nature of work taking place in an active restrictive setting, the Owner and Architect advise the Contractor to establish a Safety Committee, consisting of the Job site Superintendents for each subcontractor, to monitor job site safety, report violations, and maintain protective devices and warnings in accordance with OSHA guidelines. Access around the existing site by Fire Department must be maintained during the construction time period.

B) **Cleanup and Recycling:** Since the accumulation of trash and debris can contribute to unsafe and unclean site conditions, the Owner and Architect advise that the Safety Committee described in Paragraph A) be responsible for coordinating the removal and storage of debris at remote locations until it can be safely removed from the site. Cleaning of site and building shall be done daily with scheduled intervals (preferably weekly) for large- scale cleanup and removal of debris from the workplace.

Coordinate material separation for recycling. Maintain a cardboard recycling program, masonry materials recycling program and coordinate with the Wake County and City of Raleigh solid waste department for recycling program for gypsum board and other reusable building products.

C) **Record Keeping of Recycling Materials:**

1. Contractor shall maintain records of all recycling and material disposal of non-hazardous debris.

2. Provide a general description of waste, location of receiving agent, quantity of material in tons or cu.yds. (cardboard, gypsum board, concrete. act tile, plastic, masonry, metals, glass, carpet, insulation, clean wood.....)

3. Recycler shall provide monthly reports to contractor and architect.

END SECTION

SECTION 015000: CONSTRUCTION FACILITIES & TEMPORARY CONTROLS

PART 1: GENERAL Section Includes

A. Temporary utilities.
B. Protection of Work.
C. Barriers and fences.
D. Project and Individual identification.
E. Field storage.

1-01: **TEMPORARY FACILITIES & SERVICES** shall be provided by the Prime Contractor and shall include, but not be limited to, the following:

A. **STRUCTURES** Due to site and staging area limitations, Prime Contractor shall provide at the site only those temporary structures necessary for storage of tools and limited materials. Locate structures as directed by Architect and Owner.
Field Offices and Sheds

1). Office: Prime Contractor shall provide a temporary office on site. That can be in the Tenant Suite.

2). Tools and Building materials shall be stored in a facility provided by the Prime Contractor.

Structures shall be soundly constructed, secure and waterproof. Prime Contractor shall provide, maintain and pay for a separate telephone service to field representative or "office" at time of project mobilization.

B**. WATER** Prime Contractor shall be responsible for temporary water needed for construction. Owner's source of water shall be determined by Owner's Representative. At the time water is available to the required work from permanently installed lines through the main water meter or valves, the temporary source shall be abandoned and all connections removed by the Prime Contractor. All temporary connections shall be done by the Prime Contractor and shall be removed upon completion of the work. Cost of all connections and water used for the construction of the work shall be paid by the Prime Contractor.

C. **SANITARY FACILITIES** Contractor shall provide and maintain required temporary sanitary facilities at areas convenient to the work in process but accessible for maintenance and cleaning. Location and type of units shall be subject to the approval of the **Wake County Health Department**. Maintain in clean and sanitary condition on a regular basis.

D. **ELECTRICAL POWER** Contractor shall coordinate with power company the routing and installation of temporary power poles to the construction site. Location of meter base and power pole routing shall be reviewed by A/E and Owner. All costs for temporary routing of lines, meter base and power usage during construction shall be paid for by the Prime Contractor until a Certificate of Compliance is received and permanent power delivered to the building in the Owner's name.
Temporary source system, OSHA and UL approved, for the distribution of temporary power to the areas of work. Location of portable panels and/or connections to Owners' permanent service, if approved by the Owner in remote locations, shall be reviewed by the Owner, Electrical

Engineer and the Electrical Inspector. Temporary connections shall be removed and damage to the existing system shall be repaired by the Prime Contractor upon completion of the work. Cost of connections and usage shall be paid by the Prime Contractor.

E. **CONTRACT LIMITS**

The Contract Area Limits, within the property lines, as shown on the Site Drawing, represent the areas of confined construction activity. Storage of materials, staging, parking of personnel vehicles and other construction-related activities shall be restricted to these limits, except by permission of the Owner or required access to utilities and as defined on the site plans. Exception to the basic limit of construction line at the site is indicated to permit that site storm lines might be extended into the adjacent contract site. Owner shall provide specific permission letters from the owning agency to contractor prior to commencement of any demolition work related to the adjoining or span property line.

F. **DIRECTIONAL SIGNS** Directional signage may be erected on the site subject to the approval of the Owner and City Inspections Department (Sign requirements) with respect to size, style and location. Signage may bear the name of the Prime Contractor and a directional symbol. No other signs will be permitted except by permission of the Owner. Signage erected off site shall be at the discretion of the Prime Contractor and subject to the approval of NCDOT and the City/County Planning and Inspections Department.

G. **WATER & DEBRIS CONTROL** Conform at all times with current erosion and water run-off ordinances. Contractor shall keep adjacent drives, parking lots, streets and private property free from construction materials, siltation, mud from tires and accumulated trash and debris. Prime Contractor shall control construction debris and waste material by periodically removing from site into approved landfills. Burning of trash and debris will not be permitted on property.

H. **TEMPORARY HEAT**

Prime Contractor shall provide heat necessary for expediting the work. All exterior openings shall be temporarily weatherproofed until permanent enclosing elements have been installed. Types of heating units used shall be the responsibility of the Prime Contractor and approved by the Inspections Division of Wake County / City of Raleigh and the Wake County Fire Marshal. Temporary heat shall be operable during the heating season for temperatures of 45 degrees F. and below. Duration of temporary heat shall be until permanent boilers have been inspected and approved for firing, at which time temporary heat shall be suspended and permanent heat furnished by Prime Contractor for final curing and temperature stabilization of building.

Prime Contractor shall be responsible for providing filters for duration of use prior to Owner occupancy. Owner shall not be responsible for costs of permanent heating until Certificate of Compliance is obtained by Prime Contractor. Extended Warranties on permanently installed HVAC equipment for temporary use shall be paid by the Prime Contractor; no permanent warranties will be in effect until building is accepted entirely by Owner and A/E.

I: **PROTECTION OF INSTALLED WORK**

Protect installed Work and provide special protection where specified in individual specification Sections.

J: **BARRIERS AND FENCING** Provide fencing as determined at the preconstruction conference for security control and for the protection of Owner and adjacent land owners. Location shall be adjusted, if necessary, during the progress of the work.
All staging areas shall be enclosed by min. 6 ft. high chain link fence, gates to be kept locked after work hours.

K: PARKING:
All construction personnel must park on the immediate construction site in designated areas.

L: **FIELD STORAGE AND TRAFFIC:**
Material storage shall be weather-tight with fire protection and ventilating systems along with security provisions. If storage trailers are to be located on site, for storage purposes, location shall be approved by the Owner.

The Contractor shall be responsible to meet all protection requirements in each section of these specifications. All materials except masonry, steel, and asphalt shall be stored in trailers. All deliveries shall be coordinated with the Owner to minimize disturbance possible to residential neighborhood operation and activities. The security of all stored materials and equipment shall be the responsibility of the Prime Contractor.

No more than one week of the materials for the project may be stored on site at any time during construction.

END OF SECTION

SECTION 017800: CONTRACT CLOSEOUT

PART 1: GENERAL

Following Substantial Completion and prior to Final Payment of retainage, the Contractor shall furnish to the Architect/Engineer the documents required for certifying completion of the work.

PART 2: DOCUMENTS REQUIRED

2-01: As-built Prints (1 set), Operation and Maintenance Manuals (2 bound sets) and 1 electronic copy of each.

2-02: Name and address of Prime Contractor and major subcontractors.

2-03: (Final) Application & Certificate for Payment, AIA G702 (5 copies), with 5 copies of final application, schedule of values, and copies of the certificate of occupancy issued by local inspection department to be included in the submittal binder.

2-04: Consent of Surety to Final Payment, AIA G707 or Owners Form (5 copies).

2-05: Contractor's Affidavit of Payment of Debts and Claims, AIA G706 (5 copies).

2-06: Contractors Affidavit of Release of Liens, AIA G706A (5 copies).

2-07: Letter certifying that no materials containing asbestos or Lead have been used in the construction of this project.

2-08: Contractors Warranty Letter for specific items identified in the Contract Documents, including roofing systems warranties (for finish and weather tightness) and a general building guaranty for Materials and Labor.

2-09: All above items except AS-Built prints shall be contained in 3 ring binders, clearly labeled with project name, having dividers labeled as to contents of addressed section. One (1) electronic copy to also be given.

END OF SECTION

DIVISION 2

EXISTING CONDITIONS

SECTION 024000: DEMOLITION

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to the work covered by this Section.

1-02: Work Included: This section includes the labor, material, to provide demolition as shown on drawings and as listed below:

Interior Demolition:
- Existing building structures as indicated on the Drawings.

1-03: Standards: Except as modified by governing codes and these specifications, comply with all applicable provisions and recommendations of ANSI A10.2, Safety Code for Building Construction.

1-04: Utility Companies: Notify A/E of work required by Utility Companies not designated on plans. Work by Utilities shall include disconnecting, removal and reinstallation of respective piping or conduit to point of metering, service entrance or designated valve. No work shall be done to any existing lines without Utility Company knowledge and approval.

PART 2: PROTECTION

2-01: "North Carolina One Call Center"
Prior to commencing any work, notify **"North Carolina 811"** (1.800.632.4949 or www.nc811.org) for establishment of all known underground utility lines. Maintain all site markings in good condition, except in case of removal.

2-02: Discovery of Hazardous or Contaminated Material: Make explorations and probes as necessary to ascertain any required protective measures before proceeding with demolition and removal. Should any toxic or contaminated material be discovered, immediately notify the Owner and the Architect/Engineer. If material in liquid form is disturbed, take precautions to contain material with earthen dike or berm in order to prevent run-off into adjacent waterways, sewer easements, storm water systems and public streets. If any underground storage tank or container is encountered, stop work immediately in vicinity and notify the Owner's Project Manager.

2-03: Provide, erect and maintain barriers, warning signs and other items as required for proper protection of workmen engaged in demolition operations, the general public and adjacent construction.

2-04: Take necessary precautions to prevent mud and debris from being deposited on corridors, sidewalks or parking areas. Maintain all temporary entranceways into the site in good condition until more permanent paving and drainage systems are in place.

2-05: Provide temporary fire protection measures in accordance with Wake County Fire Marshal requirements.

PART 3: WORKMANSHIP

3-01: Demolition and hauling work shall be performed to the extent shown on drawings. Perform required work, particularly work involving removal of subsurface items, with extreme care.

END OF SECTION

DIVISION 3

CONCRETE

SECTION 033000: CAST-IN-PLACE CONCRETE (for repair work only)

PART 1: GENERAL

1-01: General: The General Conditions of the Contract, Supplementary Conditions and Division 1 contain requirements relevant to the work covered by this section.

1-02: Work Included: This section includes the labor, materials, equipment, and related services necessary to furnish and install cast-in-place concrete as shown on drawings and specified herein. Concrete for walks and other paving, is included in this section. Note requirements for Special testing related to footing and foundations at this project. Special testing if required by the building inspection official shall be by the Owner's consultant.

1-03: Substitutions: For purposes of establishing the type and quality of materials required for work included in this section, manufacturer's names, types, patterns, etc., are used. Equal products of other manufacturers must be accompanied by supporting technical literature, samples, and performance data for comparative evaluation.

1-04: Quality Assurance:

1) "Specifications for Structural Concrete for Buildings (ACI 301)", latest edition. ACI Standard 301 is hereby made a part of this specification to same extent as if bound herein. ACI 301 shall be amended, supplemented or deleted as required by this project. The Contractor shall keep a copy of ACI 301 in field office at all times. This standard may be obtained from the American Concrete Institute, P.O. Box 9094, Farmington Hills, Michigan 48333-9094.

2) CRSI "Manual of Standard Practice".

3) ACI 318 Building Code Requirements for Reinforced Concrete.

4) ACI 315 Details and Detailing of Concrete Reinforcement..

5) ACI 302.1R - Guide for Concrete Floor and Slab Construction.

6) ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

7) ACI 305 - Hot Weather Concreting.

8) ACI 306 - Cold Weather Concreting.

9) ACI 347 - Recommended Practice for Concrete Formwork.

10) "Building Official" as referred to in ACI publications shall be the Owner or Owner's Representative.

11) Secure Engineer's approval prior to placing concrete for all sub-grades, footings, forms, reinforcing, framed floors and construction joints.

12) The testing lab will perform sampling, testing and reporting during concrete placement, as follows:

a. Sampling: ASTM C 172.

b. Slump: ASTM C 143, one test for each load of point of discharge (at end of pump hose).

c. Air Content: ASTM C 231 for normal weight concrete; ASTM C 173 for lightweight concrete, one for each set of compressive strength specimens.

d. Compressive Strength: ASTM C 39, one set for each 50 cu. yds. or fraction thereof of each class of concrete; 2 specimens tested at 7 days, 2 specimens tested at 28 days, and two retained for later testing if required.

13) Non-complying test results will initially be reported by phone to the Owner, Architect, Contractor and concrete producer on the same day test are made. All results will be communicated in written reports.

14) Concrete work not in compliance with requirements of the contract documents will be rejected, removed and replaced immediately.

1-05: Submittals:

1) Submit electronic copies of shop drawings to A/E for approval before fabrication and installation.

2) Submit electronic copies of concrete mix design proportions: Proportion mixes by either laboratory trial batch or field experience method, complying with ACI 211.1. Submittals without proper documentation will be rejected. Submit written report to Architect/Engineer and Owner of each proposed concrete mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and are acceptable to Architect/Engineer. Propose separate design mix for pumped concrete.

3) Submit electronic copies of reinforcement shop drawings for fabrication, bending and placement of concrete reinforcement. Show bar schedules, spacing and arrangement. Show all openings, depressions and slope-to-drain elevations.

1-06: Delivery, Storage and Handling: Deliver steel reinforcement to job site bundled, tagged and marked. Use metal tags indicating bar size, lengths and other data concerning placement. Store steel reinforcement at job site in a manner to prevent damage and accumulation of dirt and excessive rust. Deliver transit mixed concrete from approved batching and mixing plant in accordance with ASTM C94.

PART 2: PRODUCTS (SEE PART 3: EXECUTION)

PART 3: EXECUTION (ACI 301 Supplemental Requirements)
CHAPTER 1: GENERAL
(1.7) Submit 6 copies minimum of shop drawings in accordance with Para. 1-05 of these specifications.

CHAPTER 2: MATERIALS FOR CONCRETE
(2.1.1) Portland Cement: ASTM C 150, Type I, or Type II all by the same manufacturer.
(2.2.1) All chemical admixtures must be approved by Architect/Engineer. The following admixtures are approved; any substitutions must be submitted for approval in accordance with Para. 1-03.
(2.2.1.1) Air-entraining admixtures, ASTM C260: MB-VR by Master Builder's Company; Darex AEA; Protex AES; or equal products submitted under Para. 1-03.
(2.2.1.2) Water-reducing, retarding and accelerating admixtures, ASTM C494: Pozzolith by Master Builders Co.; WRDA by W.R. Grace & Co.; Protex PDA; or equal products submitted under Para. 1-03.
(2.4.1) Aggregates: ASTM C 33 for normal weight and ASTM C 330 for lightweight. Lightweight concrete is to have a maximum unit weight of 115 lbs. per cu. ft. Local aggregates not complying with ASTM C 33 but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Architect.
Aggregates used at exterior paving and sidewalks called for to be "white" concrete shall be made using white cement, sand and aggregate. Samples of mix and "white" concrete shall be submitted for review and approval.

CHAPTER 3: PROPORTIONING

(3.2) Design mix to provide concrete and grout with the following properties:

a. Building foundations, frame, slabs and site items; regular weight (145 pcf) 3000 psi 28-day compressive strength. (Note 4,000 psi, 28 days compressive strength required at site sidewalks).

b. Slab on metal deck; Regular Weight (145 pcf) 4000 psi 28-day compressive strength.

(3.2.1) Concrete strength and type (regular or lightweight) shall be as shown on structural drawings. Type III Cement (high early strength) shall not be used.

(3.4.1) Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content with the following limits.

Concrete structures and slabs exposed to freezing and thawing or subjected to hydraulic pressure:

4% for maximum 2" aggregate.
6% for maximum 3/4" aggregate.
7% for maximum 1/2" aggregate.

Other Concrete: 2% to 4% air

(3.4.2) Water Cement Ratio: Concrete exposed to weather less than 0.50 and concrete subject to deicers less than 0.45. White cement for use in exterior walks and/or slabs labeled "white" concrete shall have a higher ratio of white cement sim. to white cement manufactured by AALBORG Portland.

(3.5) Slump limits: Proportion and design mixes to result in concrete slump at the point of placement as follows:

a. Reinforced Foundation Systems: Not less than 3" and not more than 5".

b. All Other Concrete: Not less than 2" and not more than 4".

(3.7.1) The use of calcium chloride will not be permitted.

(3.8.2) Proportioning of regular stone concrete shall be by Method 1, subject to the exclusions stated herein; all others to be by Method 2. Mix design for all classes of concrete to be used shall be prepared by an independent testing laboratory for the approval of Architect. The cost of services for the preparation of design mix shall be paid by Contractor.

CHAPTER 4: FORM WORK

(4.1.3) Where soil conditions permit excavation and placing of concrete to accurate dimensions without cave-ins or deformation of supporting soil, forms may be omitted as approved by Engineer.

CHAPTER 5: REINFORCEMENT

(5.2.1) Reinforcing bars shall conform to ASTM A 615, Grade 60, deformed. Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications. Wood, brick and concrete masonry unit supports may not be used except that concrete bricks may be used in footings only.

(5.5.4) Welded wire fabric in structural slabs shall conform to ASTM A 185 and shall be considered load carrying reinforcement. Provide welded wire fabric in sheets, not rolls.

CHAPTER 6: JOINTS AND EMBEDDED ITEMS

(6.1.4) All construction joints where shown on drawings shall be bonded.

(6.2.2) Pre-molded expansion joint filler shall be 1/2" thick unless otherwise indicated on drawings, and shall be Type 2. Filler shall be full width and depth of abutting sections. Where in contact with joint sealers, filler shall be compatible with joint sealer.
(6.4.3) Aluminum conduit or aluminum accessories shall not be embedded in concrete. Where galvanized or PVC conduit is embedded in composite floor deck, minimum distance between conduit and shear connector shall be 3". Submit proposed routing of conduit for approval.
(6.4.4) Samples of embedded items shall be submitted for the Architect/Engineer's approval. Inserts and accessories required by other prime contractors will be supplied by those contractors.
(6.5) Approval of the Architect/Engineer shall be obtained before placing sleeves through structural members unless shown on drawings.

CHAPTER 7: PRODUCTION OF CONCRETE
(7.1) Ready-mixed concrete shall be mixed and transported in accordance with "Specifications for Ready-Mixed Concrete", ASTM C94.

CHAPTER 8: PLACING
(8.1.2) No concrete shall be placed prior to approval of sub-grades, footing bottoms, forms, reinforcing and joints.
(8.4.3) No concrete shall be placed when the temperature is below 40 degrees F., and falling or when freezing temperatures are expected within 24 hours, unless written permission is obtained from the Architect/Engineer. Approval shall be for the agreed procedure only. When concreting is permitted in cold weather, ACI 306 shall be followed with the following stipulations:
1. Do not use calcium chloride, accelerators or other antifreeze admixtures.
2. Do not use Type III cement.
3. A minimum of one field test sample shall be taken for each 50 cu. yds. of concrete or portion hereof, placed each day. Three extra cylinders, in addition to laboratory-cured cylinders shall be cast and cured under the same field conditions as the concrete in the structure. These shall be used as directed to determine whether freezing occurs and to check strength of ASTM C-31 and ASTM C-39.

CHAPTER 9: UNDER SLAB VAPOR BARRIER

A. Laminated and reinforced vapor retarder shall meet or exceed ASTM E1745 Classes A,B, & C and shall be "Premium Moistop Ultra 15 Underslab " as distributed by Fortifiber Building Systems (1-800-773-4777) , Perinator 15 mil by W.R. Meadows, or Stego-Wrap 15 mil by Stego Industries, San Jaun Capistrano, CA.

B. Installation of Under-slab Vapor Barrier: Apply vapor barrier to top of crushed stone fill in widest practicable widths; lap joints not less than 6 inches. Where penetrations occur through the barrier, at edge laps at damaged areas contractor shall seal with manufacturer's seam tape, boots with sealant or seam tape to the object penetrating as required by manufacturer in their printed literature.

CHAPTER 10: FINISHING OF FORMED SURFACES
(10.2.1) Rough Form Finish: All concrete surface not exposed to public view.
(10.3.1) Smooth Rubbed Finish: All concrete surfaces exposed to public view, unless otherwise noted on drawings or specified herein.

CHAPTER 11: SLABS
(11.5.1) Joint sealer shall be "synthacaulk" as manufactured by Pecora, Inc.., or approved equal. Depth: Min. 1/4" or equal to width up to 1/2", greater than 1/2" depth equal 1/2" width.

Color: Stock color nearest color of concrete. Products of Sonneborn, Sika Chemical Corporation or equal manufacturers shall be considered under Para. 1-03 above.

(11.7) Finishes for slabs:

1. Trowel Finish:
    a. Exposed floors and floors to receive resilient tile or carpet.
    b. Tolerance Class A for floors to receive resilient tile or carpet, same as for exposed floors.
    c. Sealer:
        1. Location - all exposed concrete floors.
        2. Material and Manufacturer: "Masterseal" as manufactured by Master Builders, Sonneborn Kure-N-Seal, Sikagard, W.R Meadows or approved equal product; see Para. 3.
        3. Installation:
            a. First Coat - Surface must be sound and properly finished. Surface is application-ready when it is damp but not wet and can no longer be marred by walking. Level any spots gouged out, remove all dirt, dust, droppage, oil grease, asphalt and any other foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that surface is no more than damp, and never wet. Coat shall be applied at full strength.
            b. Second Coat - For floor areas designated for sealer type finish, a second coat shall be required to seal and dustproof. Coat shall be applied at full strength. Restore surface soundness by patching, grouting, filling crack and holes, etc. Surface must be free of any dust, dirt, oil, grease, rubber mars, and any other foreign matter prior to the application of the second coat. Follow procedures as stated above to cleanse and prepare surface. Second coat shall be applied when all trades are completed and structure is ready for occupancy.
        4. Install per manufacturers printed specifications. Submit 5 copies of these specifications for approval before proceeding. Manufacturer shall provide a trained technician to advise the Contractor on proper methods of application. Check for compatibility with adhesives used for installing resilient tile and direct-glue-down carpet. Upon completion, Contractor and manufacturer shall submit to Architect/Engineer statement of compliance with manufacturer's installation requirements.
2. Broom or Belt Finish: All exterior walks, platforms, and aprons.
3. Floated Finish: All concrete surfaces to receive ceramic tile.

CHAPTER 12: CURING AND PROTECTION

(12.1) Liquid curing compounds shall not be used on surfaces to which any type of topping or finish material is to be bonded. Curing compound shall not interfere with bond adhesives for resilient tile, carpet, or with ceramic tile setting materials.

(12.2) Approved curing methods are as follows:

1. Water curing by covering the entire surface of concrete with water. The curing water should not be more than twenty (20) degrees F cooler than the concrete.
2. Water curing by fog spraying or sprinkling to provide a continuous film of water over the entire surface of concrete.
3. Water curing by means of covering the entire surface with absorbent materials which shall be kept moist. Absorbent materials can be burlap, cotton mats, rugs, or other approved materials.
4. Curing by means of covering the entire surface with waterproof sheet materials to reduce the loss of mixing water from the concrete.
    a. Materials can be polyethylene sheeting, waterproof paper, or polyethylene coated burlap.
    b. On slabs the sheets should extend over the edges at least twice the slab thickness.

c. During cold weather black polyethylene sheeting should be used.
d. During hot weather white polyethylene sheeting should be used.
e. Do not use polyethylene on slab surfaces that will be exposed.

5. Curing by means of spraying or rolling a liquid membrane forming curing compound according to manufacturer's recommendations over the entire surface.

(12.3) Formed surfaces shall be cured by moist curing with forms in place for the full curing period.

(12.4) Minimum period of curing for all methods is seven (7) days unless a shorter period is approved by the Architect / Engineer.

CHAPTER 13: TESTING

In addition to field samples required, 6 standard cylinders (see set 1-04 on page 03300-1), 2 to be tested at 7 days and 2 to be tested at 28 days, and 2 to be retained for later testing if required, are required. A minimum of one field test sample shall be taken for each 50 cu. yds. of concrete or portion thereof placed each day. Testing Laboratory selected by Architect/Engineer and paid for by Owner shall provide both field and laboratory services and bear full responsibility for sampling and handling of concrete specimens.

CHAPTER 14: ACCEPTANCE OF STRUCTURE

(18.1) Should there be cause to suspect that air content does not meet specifications, tests shall be performed on the hardened concrete in accordance with ASTM C457 if directed by Architect.

(18.5) Fill for Concrete Masonry Units

Fill for bond beams, lintels, and at other locations shown or noted in connection with concrete masonry units, shall be as called for on structural drawings.

END OF SECTION

SECTION 033519: CONCRETE SLAB STAIN FINISH / (not needed on this project)

PART 1: GENERAL

1-01: General: The General Conditions of the Contract, Amended and Supplementary Conditions and Division 1 contain requirements relevant to the work covered by this section.

1-02: Scope of Work: This section includes the labor, materials, equipment, and related services necessary to furnish and install concrete staining in areas as indicated on Finish Schedule.

1-03: Substitutions: For purposes of establishing the type and quality of materials required for work included in this section, manufacturer's names, types, patterns, etc., are used. Equal products of other manufacturers must be accompanied by supporting technical literature, samples, and performance data for comparative evaluation.

1-04: Storage of Materials: Packaged materials shall be delivered and stored in original containers with seals unbroken and labels intact until time of use. Materials shall be stored and handled in a manner, which will prevent damage, or contamination with water or foreign matter.

PART 2: PRODUCTS

2-01: Dye N Seal to be similar to "Ameripolish" polished concrete dye system. Colors to be chosen from standard color chart. Product to be installed per manufacturer's recommendations.

PART 3: EXECUTION

3-01: Installation method shall be as follows:

1. Vacuum diamond grind the concrete slab to ensure a good stain penetration and sealer bond.
2. Repair any cracks and/or holes in the floor.
3. Mask off all walls and adjacent surfaces with plastic and painters tape.
4. Apply one coat of Dye N Seal.
5. Next apply one coat of clear epoxy primer.
6. The following day, detail the floor and apply one finish coat of clear urethane.
7. Installation to follow all OSHA and State regulations.

END OF SECTION

DIVISION 5

METALS

SECTION 054000: COLD-FORMED METAL FRAMING

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment, and related services necessary to furnish and install metal studs, channels, plates and angles for stud wall assemblies, soffits and fascias, with related accessories and specialties, called for on the drawings and specified herein.

1-03: Examination of Adjacent Work: Framing Subcontractor must examine areas to receive metal stud systems and report defects to Architect and Prime Contractor prior to installing material. Installation of metal components shall be considered as acceptance of surfaces to which system is attached.

1-04: Substitutions: For purposes of establishing type and quality of materials required for work included in this section, manufacturer's names, types, patterns, etc., are used. Equal products of other manufacturers will be acceptable, provided that request for substitutions are accompanied by supporting technical literature, samples, and performance data for comparative evaluation. Manufacturers approved for use include:

UNIMAST INC.	Schiller Park, Il.	800-323-046
DIETRICH INC.	Rock Hill, SC	803-324-4144
DALE INDUSTRIES	Dearborn, MI	313-846-9400

PART 2: PRODUCTS

2-01: Soffits: Studs for exterior and interior soffit supports shall be galvanized steel equal to UNIMAST SN studs. Widths shall be as noted on drawings. See drawings for gauges to be used.

2-02: Interior Partitions: Studs shall be channel type, roll-formed from galvanized steel not lighter than 20-gauge, equal to UNIMAST ST studs. Runners shall be formed of 20-gauge galvanized steel into channel shapes to receive stud widths as noted on drawings.

2-03: Fasteners: Secure studs to runners with fasteners equal to USG Type S-12 Pan Head; length shall be not less than 3/8". Fasteners for attaching studs to structural steel members shall be equal to Teks/4 self-drilling fasteners not lighter than #12 diameter x lengths to suit field conditions. Fasteners for all other framing conditions shall be equal to USG Type S-12 Pan Head x length to suit field conditions for proper thread penetration.
Fasteners shall be capable of withstanding 193 pounds single shear and 200 pounds bearing load without exceeding allowable design stress after installation.

PART 3: EXECUTION

3-01: Qualification of Mechanics: Work specified in this section shall be performed by mechanics experienced and skilled in erection of metal stud system components.

3-02: Installation: Cut components accurately to proper angles to fit tightly against abutting members. Framing members shall be held firmly in position until properly fastened. Track members shall be secured to concrete with powder-driven fasteners and to structural steel with self-tapping screws or by approved welding methods. Space members typically at 16" centers

elsewhere. Locate fasteners 2” from ends and at 16” centers elsewhere. Locate studs accurately, seated squarely in track with stud web and flange abutting track web, plumbed or aligned, and securely attached to flanges or webs of both upper and lower tracks. Splices in studs will not be permitted.

3-03: Stud Partition Erection: Locate runners and align accurately in accordance with details and partition layouts. Attach runners to concrete with powder-driven fasteners capable of withstanding 193 pounds single shear and 200 pounds bearing force when driven into structural head or base without exceeding allowable design stress in runner or structural support. Locate fasteners 2” from each end and at 24” on centers elsewhere. Attach ceiling runners to metal deck, structural framing or other structural elements as detailed.

3-04: Blocking and Reinforcement: Position studs plumb and vertical in runners; space 16” on centers. Provide additional studs and supplementary back-up framing members where required to support shelving, equipment or accessories, at door openings, corners, etc.
Secure studs supporting shelving, equipment or accessories adjacent to openings, at partition intersections, and at corners, to floor and ceiling runner flanges with USG Pan Head screws. Headers over openings shall be cut-to-length sections of runners with web bent at each end and secured to support with 2 minimum pan head screws. Jack studs shall be placed at vertical panel joints extending from headers to ceiling runners. Provide bracing to structure, reinforcing, and back-up members for attachment of equipment and accessories as shown on drawings for a rigid assembly.

3-05: Cut-Outs: Effective cross section of studs shall not be damaged by any trade. Sizes of cut-outs in studs shall be carefully sized to permit passage of conduit or other mechanical equipment; reinforce studs as required or directed by Architect/Engineer.

END OF SECTION

DIVISION 6

WOOD & PLASTICS

SECTION 060573: PRESSURE TREATED LUMBER

PART 1: GENERAL

1-01: Work Included: This section includes the treatment of wood to prevent decay. Species and grades of materials to be treated are specified in Section 061000: Rough Carpentry.

1-02: Materials to be treated:
a. Sole plates for shoring, walls and partitions.
b. Furring attached to concrete or masonry for attachment of gypsum wallboard.
c. Nailers and blocking required for attachment or support of roofing and flashing materials, and roof accessories.

PART 2: PRODUCTS

2-01: Decay Treatment:
Members to be treated with preservative to prevent decay shall be treated with Wolman E (CBA, Type A), Minimum net retention of 0.20 pounds per cubic foot; or, with Osmose NW 100, minimum net retention of 0.25 pounds per cubic foot. After treatment, members listed shall be air seasoned or kiln dried to a maximum moisture content of 15 percent. They shall be stored at the job site under a waterproof and weatherproof covering, and shall be elevated off the floor or ground a minimum of 12 inches.

PART 3: TREATMENT

Members listed shall be treated at an approved processing plant, and shall be identified with type of treatment and processor's name.

Materials to be treated shall be cut to finish sizes and shapes in so far as practicable; unavoidable field cuts shall be heavily brush coated with a concentrated solution of the preservative specified. After treatment, members listed shall be air seasoned or kiln dried to a maximum moisture content of 15 percent.

END OF SECTION

SECTION 061000: ROUGH & FINISHED CARPENTRY

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment, and related services necessary to furnish and install grounds, shoring, nailers, joists, studs, bracing, blocking, sheathing, etc. It also includes provision of temporary closures for doors and glazed openings as required for protection from weather and maintenance of proper temperature and humidity; and nails, screws, bolts, nuts, washers, and other fastening devices necessary for assembly and attachment of wood to wood, or wood to other materials, required to achieve results and effects specified and detailed. Nails, bolts, nuts, washers and metal hangers exposed to the weather shall be of hot-dipped galvanized steel or of aluminum. Pressure treatment to prevent decay, specified in Section 060573, is required of all lumber in contact with masonry or concrete, sills within 18 inches of grade, roof and curb blocking and other locations subject to moisture contact.

1-03: Quality Control: Each piece of lumber shall comply with American Softwood Lumber Standard PS 20-70 and with specific grading requirements of Southern Pine Inspection Bureau. Each piece of lumber shall be identified as to grade species by grade mark of recognized agency or organization certified by Board of Review, American Lumber Standards Committee, Washington, D.C.

1-04: Substitutions: For purposes of establishing type and quality of materials used in this section, manufacturers names and brand names are used. Equal products of other manufacturers may be acceptable, provided that requests for substitutions are accompanied by supporting technical literature, samples, drawings and performance data for comparative evaluation 10 days prior to receipt of Bids. Manufacturers approved for use include the following:

Georgia-Pacific Corp., (800) 243-8160.
Koppers Company, Inc., Pittsburgh PA, (800) 556-7737.
Weyerhaeuser Co., Tacoma WA, (206) 924-2345.

PART 2: PRODUCTS

2-01: Framing (minimum grades):

a) Sills - UTILITY
b) Joists, Rafters, Headers - NO. 2
c) Plates, Caps, Bucks, NO. 3
d) Studs - STUD
e) Furring (1" nom.) - NO. 3
f) Sheathing - APA RATED SHEATHING, Exposure 1.

Dimension Lumber
All framing lumber shall be dry Southern Pine No. 2, selected and grade-marked in accordance with the latest edition of "Standard Grading Rules for Southern Pine Lumber" published by the Southern Pine Inspection Bureau.

2-02: All lumber shall be kiln dried to a maximum moisture content as listed herein:
Studs plates nailers blocking and other framing lumber - max. 19%.
All roof decking - max. 15%.
Material for exterior finish lumber - max. 12% for up to 1" thickness and 14% for over 1" thickness.

2-03: Sheathing: Plywood sheathing:

a.) Sheathing @ parapets shall be 3/4" structural 1 (APA Rated 32 / 16).

2-04: Interior Wood Trim: Red Oak / see Drawings for sizes and locations.

PART 3: EXECUTION

3-01: General: Rough carpentry items shall be laid out as called for by the drawings, cut and fitted as necessitated by conditions encountered. All work shall be plumbed, leveled, and braced with sufficient nails, spikes, bolts, etc., to ensure rigidity.

a. Framing, bracing, bridging, blocking, ground and all other carpentry items shall be laid out as called for by the drawings, and shall be cut and fitted as necessitated by conditions encountered. All work shall be plumbed, leveled, and braced with sufficient hails, spikes, bolts, etc., to ensure rigidity.

b. Any piece of wood or other carpentry material with a defect or defects that prevent it from serving its intended purpose satisfactorily, including crooked, warped, bowed, or otherwise defective materials, even if within the limits of the grade specified, will be rejected and shall be replaced with an acceptable piece.

3-02: Defective Material: Any piece of wood or other carpentry material defective to prevent it from serving its intended purpose (including but not limited to crooked, warped, bowed, checked, gouged or other defects) within limits of grade specified will be rejected and shall be replaced with an acceptable piece.

3-03: Wood Blocking and Nailers:

1) Provide wood blocking, stripping, and shimming necessary to maintain lines and to support finishes called for by drawings.

2) Provide wood blocking, nailers and grounds as necessary to receive engaging woodwork, cabinets and other finished items, and for support of plumbing fixtures, accessories in toilets, and other similar items.

3) Secure wood blocking, nailers, grounds, etc., called for by drawings and by job conditions in place with approved types and sizes of nails, ties, bolts, inserts, etc., spaced so as to provide rigid support.

4) All concealed wood blocking shall be noncombustible treated as required by code.

3-04: Siding installation: All panels and trim to be installed with galvanized nails in full compliance with the manufacturer's instructions and the NC Code.

END OF SECTION

DIVISION 7

THERMAL & MOISTURE PROTECTION

SECTION 072000: INSULATION

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment, and related services required to furnish and install thermal and sound insulation as indicated on drawings and specified herein.

1-03: Substitutions: For purpose of establishing type and quality of materials required for work included in this section, manufacturer's names and brand names are used. Equal products of other manufacturers will be acceptable, provided that requests for substitutions are accompanied by supporting technical literature, samples, drawings, and performance data for comparative evaluation 10 days prior to receipt of Bids.

Products approved for use on this project include:

Rigid Insulation:

Dow Plastics Midland, MI
Amoco Foam Products Co. Smyrna, GA
Owens-Corning, Toledo, OH

Batt Insulation:

Celotex Building Products Division, Tampa, FL
Certainteed , Valley Forge, PA
Owens-Corning, Toledo, OH

1-04: Delivery and Storage of Materials: Materials shall be delivered in their original unopened packages and shall be stored under cover which will provide protection from damage and from exposure to elements and ultraviolet rays. Remove damaged, deteriorated, or wet materials from site. Installation and concealment of plastic foam insulation shall be completed as rapidly as possible in each area of work. Handle all material carefully to prevent undue stress and delamination or cracking of face sheets.

PART 2: PRODUCTS

2-01: Rigid Perimeter and Cavity Wall Insulation:

a) **Insulation** at perimeter slab edge as shown on drawings shall be extruded polystyrene foam in rigid sheets equal to Dow's STYROFOAM SM Brand plastic foam, as listed below.

Thermal resistance:	R-Value /inch 75F mean temp.5.0	ASTMC518
Water absorption:	0.1 % max.	ASTMC272
Water vapor permeance:	0.4-1.1	ASTME96
Flame spread:	5	ASTME84
Smoke developed	165	ASTME84

b) **Thickness:**

• Boards at slab perimeter shall be 2" thick x 36" wide, min. 25 psi compressive resistance.

c) **Cavity Wall Insulation:** Carlisle R+Silver, 2" thick (R15) to be attached to the Armatherm girt system. 6" batt insulation per 2-02 below at all metal stud exterior walls.

NOTE: ARMATHERM GIRT ONLY AT ALUMINUM PANELS.

2-02: Batt Insulation (Interior locations only as shown on drawings)**:**

a) Insulation shall consist of spun glass fibers into blankets designed for installation in wall assemblies which utilize metal studs. Insulation shall conform to requirements of ASTM E84 for flame spread of 25, fuel contribution of 50, and smoke development of 50.

b) Interior Partitions: Blankets shall be un-faced type, 6" thick (nom.) in 6" metal stud partitions and 3-1/2" thick (nom.) in 4" metal stud partitions.

2-03: Adhesives:

a) For adhering rigid insulation to masonry, plywood or gypsum board: Dow's General Purpose Mastic No. 11. See paragraph 3-01 below.

b) For adhering batt insulation to gypsum sheathing board where required: Kentucky Adhesive Co., Inc. KAC J-545-F.

PART 3: EXECUTION

3-01: Installation of Batt Insulation in Vertical Wall Application

Batt Insulation in stud walls shall be adhered to back of gypsum board with adhesive specified. Adhesive shall be applied in accordance with manufacturer's recommendations for quantity and methods. Installation shall contain no gaps, thin spots, or breaks except where necessary for passage of mechanical or electrical services. Units in walls shall be fitted snugly between studs, against each other, and against runners and other adjoining construction members, to provide greatest possible resistance to passage of heat. Blankets in exterior walls shall be attached to sheathing with 9/16" staples having divergent points, placed at each corner.

3-02: Installation of all insulation shall be in accord with manufactures' written instructions. Vapor barrier/interior finish shall be installed towards heater space. Required supporting members shall be used at horizontal and vertical surfaces to prevent excessive "sag" of roll insulation. All joints shall be sealed using approved tape, to be supplied with insulation.

3-03: Rigid masonry cavity wall insulation shall be installed horizontally beginning at bottom of cavity, slightly above lower portion of thru wall flashing, and secured to cured dampproofing masonry wall with adhesive specifically recommended by manufacture of insulation. Stagger joints between courses and place to maximize contact bedding with tight ends and butt edges. Boards shall be extended over expansion joints, un-bonded on one side of joint.

END OF SECTION

DIVISION 8

OPENINGS (DOORS & WINDOWS)

SECTION 081100: METAL DOORS AND FRAMES

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this Section.

1-02: Scope of Work: This section includes labor, materials, equipment, and related services necessary to furnish and install the following:

Hollow metal doors (swinging, flush, glazed, louvered).
Hollow metal frames (for single doors, doors w/transoms and/or sidelights, and for multiple or combination openings).
Labeled hollow metal doors and frames.
Hollow metal panels.
Hollow metal fillers, closures, or covers.

1-03: Shop Drawings: Submit electronic copies minimum of shop drawings showing elevations and details of each door and frame type; location in the building for each item; conditions at openings with various wall thickness and materials; typical and special details of construction; methods of assembling section; type of shop primer with dry mil thickness; locations and installation requirements for hardware; size, shape, and thickness of materials. Materials shall not be delivered to site until drawings have been reviewed by Architect. Doors and frames shall be manufactured by same manufacturer.

1-04: Storage: Doors and frames shall be stored at the site under cover, above grade, in a manner which will prevent physical injury or damage due to moisture. Care shall be taken to avoid creating a humidity chamber by not properly venting the area covered.

1-05: Substitutions: For purposes of establishing type and quality of materials required for work in this section, manufacturer's names and brand names are used. Equal products of other manufacturers will be acceptable provided that requests for substitutions are accompanied by supporting technical literature, samples, drawings and performance data for comparative evaluation 10 days prior to receipt of Bids. Products approved for use shall include:

Steelcraft, Cincinnati, Ohio., 800.930.8585.
Windsor Republic Doors & Frames, McKenzie, TN 800.733.3667
Curries Co., Mason City, Iowa 641.423.1334.

1-06: Hardware Locations: Unless dimensioned otherwise on drawings, the location of hardware on doors and frames shall be as follows:

Hinges: Top - 9+-"to max 11 3/4" from bottom of frame head to centerline of hinge.
Bottom - 10 3/8" to 13" from bottom of frame to centerline of hinge.
Intermediate - centered between top and bottom hinges, equally spaced.
Unit and Integral Type of Locks and Latches - 39-40" from bottom of frame to centerline of knob, lever, or strike.
Deadlocks - 48" from bottom of frame to centerline of cylinder.
Panic Hardware - 39-40" from bottom of frame to centerline of crossbar.
Door Pulls - 42" from bottom of frame to center of grip.
Push-Pull Bars - 42" from bottom of frame to centerline of bar.
Arm Pulls - 41 1/4" from bottom of frame to centerline of lower base
Push Plates - 41 1/4" from bottom of frame to centerline of plate.
Roller Latches - 38" from bottom of frame to centerline.

1-07: Clearances: Provide edge clearances as follows:

Between doors and frame, at head and jambs - 1/8".
At door sills without thresholds - 3/8" max. above fin. fl.
At door sills with thresholds - 3/4" max. above fin. fl.
Between meeting edges of pairs of doors - 1/8".

Note that "finished floor" is defined as the top surface of the floor except that when resilient flooring or carpet is used - when it then becomes the top of the concrete slab. Where the carpet exceeds 1/2" in depth, allow 1/4" clearance max. above the top of the carpet.

PART 2: PRODUCTS

2-01: Hollow Metal Frames:

a) **Material:**

1) Frames for exterior openings shall be made of commercial grade cold-rolled steel conforming to ASTM A366-68, not less than 14 gauge, and shall have a zinc coating of not less than 0.60 oz. per sq.ft.

2) Frames for interior openings shall be made of either commercial grade cold-rolled steel conforming to ASTM A366-68 or commercial grade hot-rolled and pickled steel conforming to ASTM A569-66T. Metal thickness shall be not less than 16 gauge for frames in openings 48" or less in width, and not less than 14 gauge for frames in openings over 48" in width.

b) **Design and Construction:**

1) All frames shall be custom-made welded units with integral trim, of the sizes and shapes shown on approved shop drawings. Knocked down frames will not be acceptable.

2) All finished work shall be strong and rigid, neat in appearance, square, true and free of defects, warpage or buckling. Moulded members shall be clean cut, straight and uniform in profile throughout their lengths.

3) Jamb depths, trim, profile and backbends shall be as scheduled by the Architect and as shown on approved shop drawings.

4) Corner joints shall have all contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets will not be permitted.

5) Minimum depth of stops shall be 5/8". Cut-off (sanitary or hospital type) stops, where scheduled, shall be capped at 90 degrees at heights shown on approved shop drawings, and all jamb joints below cut-off stops shall be ground and filled smooth, making them imperceptible. Do not cut off stops on frames for soundproof, light-proof or lead-lined doors.

6) When shipping limitations so dictate, fabricate frames for large openings in sections designed for splicing in the field by others.

7) Frames for multiple or special openings shall have mullion and/or rail members fabricated from closed tubular shapes having no visible seams or joints.
All joints between faces of abutting members shall be securely welded and finished smooth.

8) Hardware Reinforcements:

a) Frames shall be mortised, reinforced, drilled and tapped at the factory for fully templated mortised hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only; all drilling and tapping shall be done by General Contractor.

b) Minimum thickness of hardware reinforcing plates shall be as follows:

Hinge & pivot	-	7 gauge, 1-1/4" x 10".
Strike	-	12 gauge.
Flush bolt	-	12 gauge.
Closer	-	12 gauge.
Surface-mounted	-	12 gauge.

Hold-open arms - 12 gauge.
Surface panic - 12 gauge.

9) Floor Anchors:

a) Securely weld floor anchors inside each jamb for anchorage to floor.

b) Where scheduled or specified, provide adjustable floor anchors capable of not less than 2" height adjustment.

c) Minimum thickness of floor anchors shall be 14 gauge.

10) Jamb Anchors

a) Frames to be installed in masonry walls shall be provided with adjustable jamb anchors of the T-Strap type, not less than 16 gauge.

The number of anchors provided on each jamb shall be as follows:

Frames up to 90" high - 3 anchors.
Frames 90" to 96" high - 4 anchors.
Frames over 96" high - 1 anchor for each 24" or fraction thereof

b) Frames to be installed in stud partitions shall be provided with steel anchors of suitable design, not less than 18 gauge thickness, securely welded inside each jamb as follows:

Frames up to 90" high - 4 anchors.
Frames 90" to 96" high - 5 anchors.
Frames over 96" high - 5 anchors + 1 additional for each 24" or fraction thereof over 96".

c) **Frames to be anchored** to previously placed concrete, masonry or structural steel shall be provided with anchors of suitable design and quantity as shown on approved shop drawings. Fasteners for such anchors shall be provided by General Contractor.

11) Frames to be installed in masonry wall openings more than 48" in width shall have any angle or channel stiffener welded into the head. Such stiffeners shall not be less than 12 gauge steel and not longer than the opening width, and shall not be used as lintels or load-bearing members.

12) Dust cover boxes for mortar guards of not thinner than 26 gauge steel shall be provided at all hardware mortises on frames to be set in masonry or plaster partitions.

13) Provide all frames with a steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping and handling.

14) Loose glazing stops of cold-rolled steel, not less than 20 gauge thickness, shall be butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Secure glazing stops to interior side of frame or the locked room side for interior frames.

d) **Finish:** After fabrication, remove all tool marks and surface imperfections, and dress smooth exposed faces of all welded joints. Chemically treat frames to insure maximum paint adhesion and coat all accessible surfaces with a rust-inhibitive primer which should be fully cured before shipment.

2-02: Hollow Metal Doors:

a) **Materials:** Doors shall be made of commercial quality, level, cold-rolled steel conforming to ASTM A366-68, free of scale, pitting or other surface defects. Face sheets for interior shall be not less than 16 gauge; face sheets for exterior doors shall be not less than 14-gauge and shall have a zinc coating of not less than 0.60 ounces per square foot.

b) **Design and Construction:**

1) All doors shall be custom made, of the sizes and types shown on approved shop drawings, and shall be fully welded seamless construction with no visible seams or joints on their faces of vertical edges. Minimum door thickness shall be 1-3/4".

2) All doors shall be rigid and neat in appearance, free from warpage and buckle. Corner bends shall be true and straight, bent to the minimum radius for the gauge metal being used.

3) Face sheets shall be stiffened by continuous vertical formed sections of steel spanning the interior space between door faces. These stiffeners shall be not less than 22-gauge, spaced not more than 6" apart and be securely fastened to face sheets by spot welds not more than 5" o.c. Spaces between stiffeners shall be sound-deadened and insulated the full height of the door with an inorganic non-combustible material.

4) Door faces shall be joined at their vertical edges by a continuous weld extended the full height of the door. All such welds shall be ground, filled and dressed smooth to make them invisible and provide a smooth flush surface.

5) Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending the full width of the door and spot welded to both faces. Exterior doors shall have an additional flush closing channel at their top edges and, where required for attaching weatherstripping, a flush closure also at their bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of any entrapped moisture.

6) Edge profiles shall be provided on both vertical edges of doors as follows:

- Single-acting swing doors - beveled 1/8" in 2".
- Double-acting swing doors - rounded on 2-1/8" radius.

7) All hardware supplied for single-acting doors shall be designed for beveled edges as specified.

8) Hardware Reinforcement

a) Doors shall be mortised, reinforced, drilled and tapped at the factory for fully templated and approved hardware only. Where surface-mounted hardware (or hardware requiring adjustment in the field such as top and bottom pivots, floor closers, etc.) is to be applied, doors shall have reinforcing plates only; all drilling and tapping shall be done by General Contractor.

b) Minimum gauges for hardware reinforcing plates shall be as follows:

- Hinge & Pivot reinforcements - 7 gauge.
- Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers - 12 gauge.
- Reinforcement for all other surface-mounted hardware - 16 gauge.

9) Glass Mouldings & Stops

a) Where specified or scheduled, doors shall be provided with hollow metal mouldings to secure glazing by others in accordance with glass opening sizes shown on approved shop drawings.

b) Fixed mouldings shall be securely welded to the door on the security side.

c) Loose stops shall be not less than 20 gauge steel with butt corner joints, secured to the framed opening by cadmium or zinc-coated countersunk fasteners. Snap-on attachments will not be permitted.

c) **Finish:** After fabrication all tool marks and surface imperfections shall be dressed, filled and sanded as required to make all faces and vertical edges smooth, level and free in irregularities. Doors shall then be chemically treated to insure maximum plant adhesion and shall be coated on all exposed surfaces with a rust inhibitive primer which is fully cured before shipment.

2-03: Hollow Metal Panels: Hollow metal panels shall be made of the same materials, constructed and finished in the same way as specified for hollow metal doors.

2-04: Labeled Doors and Frames:

a) Labeled doors and frames shall be provided for those openings requiring fire protection ratings as determined and scheduled by the Architect. Such doors and frames shall be constructed as tested and approved by Underwriters' Laboratories using the most current standards.

b) If any door or frame specified to be fire-rated cannot qualify for appropriate labeling because of its design, size, hardware or other reason, the Architect shall be notified before fabrication of that item begins.

c) Fire doors or frames that do not qualify for labeling will be furnished non-labeled. However, if material specified as fire-rated and labeled can be obtained from any source, no consideration will be given to those manufacturers who are not authorized to fabricate and label such items.

PART 3: EXECUTION

3-01: Site Storage and Protection:

a) The General Contractor shall be responsible for seeing that any scratches or disfigurement caused by shipping or handling are promptly cleaned and touched up with a rust-inhibitive primer, and that materials are properly stored above ground on timbers or pallets in a dry location, and covered to protect them from damage.

b) Doors shall have their wrappings or coverings removed upon delivery at the building site and shall be stored, preferably inside, in a vertical position, spaced by blocking to permit air circulation around them.

3-02: Prior to installing frames, the General Contractor shall check frames and correct for rack, twist and out-of-square. Set frames plumb and level, in alignment until permanently built into the wall.

3-03: Frames shall be secured to structure as indicated or noted. Floor knees shall be attached to concrete with two powder-actuated fasteners at each jamb. Masonry anchors shall be built-in, and frames filled with mortar as wall is laid up. Frames in dry wall areas shall be filled with grout. Frames shall be installed plumb, square, and in proper alignment with adjacent wall surfaces. Protection shall be provided against physical damage and surface contamination which might prevent acceptable application of field applied finish specified in Section 099000.

END OF SECTION

SECTION 081400: WOOD DOORS

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment, and related services necessary to furnish and install wood doors as called for by drawings (Door Schedule) and as specified herein. See the following sections for related work:

Section 081100 Steel Doors & Frames
Section 087000 Finish Hardware
Section 088000 Glass & Glazing
Section 099000 Painting

1-03: Submittals: Submit electronic sets shop drawings scheduled to show door elevations, construction, swing, label, undercut and applicable hardware locations. Show dimensions and detail openings for glass lites, louvers and grilles. Submit actual veneer samples of doors to be factory finished with the standard finishes available, or a color sample will be furnished by the Architect to manufacturer for duplication.

1-04: Substitutions: For purposes of establishing type and quality of materials required for work included in this section, manufacturer's names, types, patterns, etc., are used. Equal products of other manufacturers will be acceptable, provided that requests for substitutions are accompanied by supporting technical literature, samples, and performance data for comparative evaluation 10 days prior to receipt of bids. Products approved for use include:

ALGOMA HARDWOOD, INC., Algoma WI, 800.558.8032
WEYERHAEUSER, INC., Jackson MS, 601.981.9611
VT INDUSTRIES, Holstein Iowa, (Type 5002) 712.368.4381

1-05: Delivery, Storage and Handling: No doors shall be delivered to the building until weatherproof storage space is available. Store doors in an area having controlled temperature and humidity range 30-60%. Stack doors flat and off the floor, supported to prevent warpage. Protect doors from damage and direct exposure to sunlight. Wrap factory finished doors individually in polybags to protect finish from damage. Damaged doors shall be repaired or replaced at no cost to Owner.

1-06: Quality Standards:

1) Production of wood doors shall conform with requirements of:

AWI, Sections 1300 & 1500.
NWWDA, IS-1 Series.
NEMA
NFPA

All doors shall be the product of the same manufacturer to insure uniformity of quality and appearance throughout the project. All wood doors shall be and have a "FSC Certified Wood Products" certificate. Certificate shall be delivered to the General Contractor with a copy to the Architect.

2) Labeled wood doors for this project shall be "B" Label 1-1/2 hour (90 minute), 1 hour 60 minutes, or 1/3 hour (20 minutes as listed on drawings. Underwriters Laboratories or Warnock Hersey Rating for Fire Doors. All doors in rated partitions shall be labeled. Closure hardware is required in rated partitions, unless specific areas are noted to receive door closure hardware in the door schedule. Discrepancies between architectural drawings and procedures and limitations set forth by testing

agencies shall be brought to the Architect's attention at the submission of shop drawings. Provide each fire-rated door with a label permanently attached to either the hinge stile or top rail, showing testing agency approval for classification scheduled.

3) Non-labeled wood doors shall meet construction requirements for 1/3 hour (20 minute) UL or Warnock Hersey Rating for Fire Doors.

4) One door may be randomly selected by the Architect for destruction testing to ascertain if the manufacturer has complied with specifications, if quantities warrant.

1-07: Moisture Content: Wood used in door construction shall be thoroughly seasoned, kiln-dried, with moisture content not less than 5% and not greater than 8%.

1-08: Warranty: All work in this section shall be warranted from the date of Certificate of Compliance against defects in material and workmanship, including the following:

- Delamination in any degree.
- Warp or twist of 1/4" or more in any 3.5'x7.0' section of door.
- Telegraphing of any part of core assembly through face to cause surface variation of 0.01" or more in a 3" span.
- Any defect which may in any way impair or affect performance of door for the intended purpose. Replacement under this warranty shall include hanging, installation of hardware and finishing.

Periods of warranty after date of installation:

- Interior solid or mineral core - Life of installation
- Exterior solid core - 5 year
- Interior hollow core - 5 year.

Doors must be stored, finished, hung and maintained per manufacturer's recommendations set forth in their limited warranty.

1-09: Certification: Veneer faced wood doors to have Smart Wood Certificate approved by the Rain Forest Alliance and/or be approved and certified by the FSC (Forest Steward Council).

PART 2: PRODUCTS

2-01: General: Doors shall be of sizes, thickness, and types listed in Door Schedule and shown on drawings. Door manufacturer shall coordinate hardware, door, louver and glazing schedules with door and frame shop drawings. Door manufacturer shall supply to General Contractor printed instructions and recommendations for installation; 2 copies shall be submitted to Architect before installation is begun. Verify proper clearance for door swing and threshold height installation at floor finish transitions (refer to Finish Schedule and Door sill Details).

2-02: Wood Doors: Doors shall be Premium Grade Natural Rotary Cut Select White Birch – Nutmeg 48-97 veneer faced architectural units equal to "Novodor" produced by Algoma Hardwoods. Doors shall be composed of particleboard core with stiles and rails bonded to core under side pressure with high frequency method of cure and veneered with hardwood plies.

2-03: Physical Requirements:

1) Thickness - 1-3/4"

2) Maximum Size – pre-fit or stock sizes up to 4'-0" x 8'-0", labeled (90 min.) up to 4'-0" x 8'0" max. for singles.

3) Core Construction - solid particleboard core shall conform to Type I density (28-30 pcf), Class 1, Commercial Standard #236-66. Provide core reinforcement material for surface mounted closers and exit devices as required.

4) Stiles (dimensions given are min. sizes allowed after factory trimming to book-size or pre-fitting) - 1-3/8" min. 2-ply edge strips glued to core; outer 5/8" ply species compatible with face veneer. Lamination to core on 4 sides shall conform with AWI 1300 - G-3, Spec. Symbol PC-5, PC-7 or PC-HPL.

5) Rails (dimensions given or min. sizes allowed after factory trimming to book-size or pre-fitting) - 1-3/8" min. 2-ply mill-option hardwoods.

6) Cross Bands - thoroughly oven-dried hardwoods, 1/16" minimum thickness extending full width of door and laid with grain at right angles to face veneers.

7) Adhesives - cross bands and faces shall be laminated to cores with Type I, Melamine Fortified Urea Glue using hot plate process; edge bands shall be laminated to cores with Type II water-resistant glue using high frequency method.

8) Face Veneers (Interior Doors) - veneer shall conform with AWI 200-S-7 or ANSI/HPMA HP 1983 Table 2; faces must have 0.020" thickness minimum prior to factory sanding.

2-04: Cutouts for Lights and Louvers: Edge of any opening shall be no closer than 5" to edge or top of door and no closer than 8" to bottom of door. Where kickplates occur, edge of cutout shall be 2" above kickplate. There shall be not less than 5" between any light/louver cutout and any hardware or lock cutout. See Door Schedule Drawings for cutout dimensions.

2-05: Pre-finishing: Door shall have factory-finished faces, details and stiles; rails shall be sealed. Finish shall be equal to catalyzed conversion varnish equal to A.W.I. Section 1500 System #3, Premium Grade.

2-06: Pre-machining: Doors shall be sized and machined at the factory to receive all required hardware other than surface mounted items. After hanging, maximum clearance shall be 1/8" each side and top; bottom clearance for labeled (90 min.) door shall be 1/4" over noncombustible sill, if any, or 1/2" over noncombustible floor.

PART 3: EXECUTION

3-01: General: Installation of doors shall be coordinated with application of finish hardware. Manufacturer's recommendations shall be followed in hanging doors. Surfaces shall be protected against physical damage, stain, discoloration or other injury, until project is accepted by Owner and Architect.

3-02: Machining and Fitting; All wood doors shall be machined by the manufacturer for cutouts, hinges, locks and other hardware requiring routing or mortising. Any required rabbeting to properly hang doors shall be performed by the manufacturer prior to finishing. Size doors to allow 1/8" clearance at tip and each side, and 3/4" at bottom (unless specified otherwise). Do not pre-drill for surface-applied hardware.

3-03: Installation of Hardware: General Contractor shall install hardware according to approved hardware schedule. Install hardware with full-threaded wood screws furnished by hardware manufacturer. Drill proper size pilot hole for all screws. Securely anchor hardware in correct position and alignment. Adjust hardware and door for proper function and smooth operation, proper latching, without force or excessive clearance.

3-04: Installation of Fire Doors: Fire-rated doors shall be installed according to the requirements of the labeling agency and NFPA #80 and #101.

3-05: Factory Finishing: Manufacturer shall pre-finish wood doors according to AWI Quality Standards Section 1500 Specification for System #3. Satin and semi-gloss finish will be standard unless specified otherwise. Finish samples shall be approved by the Architect prior to manufacturing or finishing of wood doors in the factory.

END OF SECTION

SECTION 087000: FINISH HARDWARE

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to the work covered by this section.

1-02: Allowance for Hardware:
Prime Contractor shall include in his Bid the following sum to cover costs of purchasing finish hardware, including but not limited to closers, exit devices, hinges, weather-stripping, seals, thresholds, sound isolation stops, astragals and other pieces for exterior and interior doors. Installation of hardware shall be included in the Prime Contractor's Base Bid separate from this allowance. Allowance for Purchasing Finish Hardware:

Hardware Base Bid: = $31,000.00 at Suite 201+208 NC Legal Aid

1-03: Hardware Schedule: Prime Contractor shall submit electronic copies of complete hardware schedule for review before hardware is ordered. Upon receipt of approval from Contractor, Supplier shall box each item of hardware separately, with each box labeled to denote contents and position in building as scheduled. Additional schedules shall be furnished for use on site.

1-04: Keying: Supplier will coordinate master keying with Owner. Supplier to furnish Architect and Contractor with schedule of groups which are to be keyed alike and which are to be keyed differently; he will also determine number of keys per lock, of master keys per group, and of grand-master keys. For Bidding purpose all interior keyed locks shall be supplied with three (3) keys for specific lock, exterior doors the use keyed locks shall be supplied with twelve (12) keys for specific lock, and Owner shall be supplied with (6) submaster Keys for two (2) submaster sets for a total of twelve (12) keys, and Owner shall be supplied with six (6) master keys.

Locks, magnetic releases, electronic strike releases and interconnection with fire alarm system shall be provided by General Contractor and manual disconnects or key releases shall be coordinated with hardware supplier, installer and Best keying system.

1-05: Substitutions: For purposes of establishing type and quality of material specified for use on this project, manufacturer's names and brand names are used. Equal products of other manufacturers will be acceptable provided that requests for substitutions are accompanied by supporting technical literature, samples, drawings and performance data for comparative evaluation 10 days prior to receipt of Bids. Manufacturer's approved for use:

Thresholds, weather-stripping	Reese Enterprises Inc., Rosemount, MN
	Pemko, Ventura, CA
	National Guard Products, Memphis, TN
Hinges	Stanley, New Britain, CN
	Hager Companies, St.Louis, MO
	McKinney, Scranton, PA
Exit Devices, Removable Mullions,	Von Duprin, Indianapolis , IN
	Yale, Charlotte, NC
	Sargent, New Haven, CT

Mortise and Cylindrical Locksets	Sargent, New Haven, CT Best Lock Corp, Indianapolis, IN Yale, Charlotte, NC
Push , Pull, Kick Plates Wall , Floor Stops, Flush Bolts	Builders Brass Works, Los Angeles, CA. Hager Companies, St.Louis, MO Trimco, Los Angeles, CA Hiawatha, Inc., Bloomington, MN
Base Stops w/ holder	Hager Companies, St.Louis, MO Trimco, Los Angeles, CA Hiawatha, Inc., Bloomington, MN
Closers • Interior and Entry	LCN, Princeton, IL Norton Door Controls, Charlotte , NC Yale, Charlotte, NC Dorma Door Controls, Reamstown, PA Rixson, Franklin Park, IL
Magnetic Holdback Device	Sargent, New Haven, CT LCN, Princeton, IL Corbin Russwin, Charlotte, NC
Overhead Holders & Stops	Dorma Door Controls, Reamstown, PA Glenn-Johnson, Indianapolis, IN Corbin Russwin, Charlotte, NC Sargent, New Haven, CT
Cylinders	GMS Industries, Redmond, WA (888.774.5625)
Firefighters Emergency Access	Knox Company (800.552.5669)"Knox Box" To be supplied and installed by Prime Contractor coordinated with Owner and City of Durham Fire Department
Sliding Door Hardware	L.E. Johnson Products, Inc., Elkhart, IN K.N. Crowder, Inc., Lewiston, NY Stanley Hardware, New Britain, CT
Key Cabinet	Lund or equal with 125% of building key capacity

PART 2: PRODUCTS

2-01: General: Hardware for doors and frames shall be made to templates and furnished with machine screws to metal and wood screws to wood.

The Prime Contractor shall coordinate Hardware Supplier with Hollow Metal Manufacturer and Door Suppliers to exchange schedules and furnish templates promptly.

2-02: Products shall be equal to the following manufacturer's no.

Thresholds	Reese "S205 Series" Pemko "171 Series" National Guard Products "425E Series"

Hinges	Stanley " FBB199" (US32D) Hager "BB1199" (ANSI A5111) SS w/ SS Pin McKinney "TRB3386" (ANSI A5111) SS w/ SS Pin
Exit Devices Note: Provide interior Cylinder Locking Option	Von Duprin " 99L Series" Yale "7000 Series" Sargent "8800 Series"
Smoke Doors	Von Duprin "9947L Series"
Security Mortise Locksets	Sargent 4213 Series, LNH Level/Rose US26D
Mortise Locksets	Sargent "8200 Series" Best Lock "30H Series" Yale "8700 Series"
Cylindrical Locksets	Sargent "10 LINE" LP trim / L rose / P Lever Best "GK Heavy Duty Series" Yale "5400 LN Series"
Removable Mullions	Von Duprin "9954"
Kick Plates	Trimco "KO050SS" (US32D) Hager "193S" (US32D) B.B.W. US26D
Push Plates	B.B.W. "Model 47" US26D
Pull Plates	B.B.W. "Model 290A/47" US26D
Mop Plates	Trimco "KM050SS" (US32D) Hager "190S" (US32D)
Wall Stops	Trimco "1270CVSV" (US26D) Hager "234W" (US32D) Hiawatha "Model 9211" US26D
Floor Stops	Trimco "Model 1210" (US26D) Hager "Model 241F" (US26D) B.B.W. "Model F8061" US26D
Base Stop with Holder Concession Bldg	Trimco "Model 18631" (US26D) Hager "Model 256W" (US26D) McKinney"Model DS22" US26D
Flush Bolts	Trimco "3917" (US26D) Hager "282D" (US26D) B.B.W. "Model 5021" US26D

Closers	Sargent 281 Series Powerglide LCN "4040 Series" (US26D) Yale "4400 Series" (US26D)
Overhead Holders & Stops	Sargent "590 Series" (US26D) Dorma "900 Series" (US26D) Corbin Russwin "DH5000 Series" (US26D) Glenn-Johnson "90 Series" (US26D)
Weather-stripping	Reese "712A", "797B", "129CP" Pemko "315CN", "588BL", "29310CP" Nat. Guard Products "200NA", "5050", "140PA"
Cylinders	Best Lock Corp. (Indianapolis, Indiana) Durham Public Schools standards. To include at Security Panel Overrides
Pad Locks	Extra heavy duty with Best Cylinder at Hatches and Gates
Magnetic Hold Back	Sargent Magnamatic "1501" (120VAC) or "1503" (24V DC & 24 VAC) (US26D) LCN "7800" (24 or 120 volt) (US26D) Corbin Russwin "DH57900 Series" (US26D)
Sliding Door Hardware	L.E. Johnson Model 200SD Series K.N. Crowder, Inc., Lewiston, NY Series C-500 Stanley Hardware, Series 2841
Door Bottom-Raindrip	Reese "R100A" Pemko "345A"

2-03: Hardware Sets: Required Hardware for this project shall be as follows:

HW SET 1:
Each to Receive:
- 3 hinges
- 1 mortise lock (office, passage or storage function)
- 1 wall stop
- 1 set mutes

HW SET 2:
Each to Receive:
- 3 hinges
- 1 mortise lock (office, passage or storage function)
- 1 overhead stop
- 1 set mutes

HW SET 3:
Each to Receive:
- 3 hinges
- 1 Exit Device with lever handle
- 1 closer with stop
- 1 kick plate
- 1 set smoke seals around

HW SET 4:

Each to Receive:

3 hinges
1 Exit Device with lever handle
1 closer with stop
1 kick plate
1 threshold
1 set weatherstripping and sweep around

HW SET 5:

Each to Receive:

6 hinges
2 Exit Devices with lever handle (intrusion lock keying inside)
1 removable mullion
1 threshold
2 closers with stop
2 kick plates
2 sets weather-stripping around (Dbl.Dr.)

HW SET 6:

Each to Receive:

6 hinges
2 Exit Devices with lever handle (intrusion lock keying inside)
1 removable mullion
2 closers with stop
2 kick plates
1 set mutes

HW SET 7:

Each to Receive:

6 hinges
2 Exit Devices with lever handle (intrusion lock keying inside)
1 removable mullion
1 threshold
2 closers with stop
2 kick plates
2 sets weather-stripping around (Dbl.Dr.)
2 rainwater deflector drip

HW SET 8:

Each to Receive:

6 hinges
2 Exit Devices with lever handle
1 removable mullion
1 threshold
2 closers
2 kick plates
2 sets smoke seals around with sill gasket (Dbl.Dr.)

HW SET 9:

Each to Receive:

6 hinges by Door / Curtain wall manufacturer
2 exit devices w/ Lever Handle by Door Manufacturer
(Surface mount type)
2 overhead surface mounted closer with stop by door
manufacturer
2 set weatherstripping and sweep by Door Manufacturer
1 threshold (full length) by Door Manufacturer
1 aluminum removable mullion by Door Manufacturer

HW SET 10:

Each to Receive:	3 hinges by Door / Curtain wall manufacturer
	1 exit devices w/ Lever Handle by Door Manufacturer (Surface mount type)
	1 overhead surface mounted closer with stop by door manufacturer

PART 3: EXECUTION

Installation of hardware is specified in Section 081100 and Section 081400.

END OF SECTION

SECTION 088000: GLAZING

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment and related services necessary to furnish and install glass in partitions, existing exterior curtain walls, interior hollow metal windows, door vision panels and sidelights, with related accessories and specialties as called for by drawings and specified herein

1-03: Substitutions: For purposes of establishing type and quality of materials required for work included in this section, manufacturer's names, types, patterns, etc., are used. Equal products of other manufacturers will be acceptable, provided that requests for substitutions are accompanied by supporting technical literature, samples, and performance data for comparative evaluation 10 days prior to receipt of Bids. Manufacturers approved for use include:

Libbey-Owen-Ford Company (Pilkington Group, Toledo, OH (800.221.0444)
PPG Industries, Pittsburg, Pa. Fabricators:
Glass Dynamics, Stoneville, NC (800.948.4027)
Oldcastle Glass, Rock Hill, SC (800-845.9486)
Hordis Glass- Guardian Industries, Rochburg, SC (803.789.6100)

Spandrel Glass Manufacturers Include:
OPACI-COAT by ICD, Inc., Vancouver WA 98685 (360.546.2286).

1-04: Reference Standards:

1) ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.
2) ASTM E84 - Surface Burning Characteristics of Building Materials.
ASTM C1036- Standard Specifications for Flat Glass
3) SIGMA No. 64-7-2 - Specification for Sealed Insulating Glass Units.
4) CPSC 16 CFR 1201 - Safety Standards for Architectural Glazing Materials

1-05: Quality Assurance: Conform to Flat Glass Marketing Association (FGMA) Glazing Sealing Systems Manual for glazing installation methods.

1-06: Submittals: Submit electronic copies of product data of each type of glass being furnished under this section. Include data on glazing sealant, gaskets, or compounds being used in various locations. Submit color chart for selection by Architect of color of proposed glazing sealants. Submit sealed glass unit manufacturer's certificate indicating units meet or exceed specified requirements.

1-07: Warranty: Provide 5-year manufacturer's warranty for sealed glass units covering seal failure, interpane misting or dusting, and replacement of same.

PART 2: PRODUCTS

2-01: General: Glass shall be furnished with labels showing strength and quality shall be attached to each piece of glass; or, if glass is not cut to size by Supplier but furnished unlabeled from local stock, Contractor shall submit an affidavit stating quality, thickness, type and manufacturer of glass furnished. Glazing products shall meet requirements of Category I and II classifications of glazing in areas required by Section 2404 of the NC Building Code and conforming with test requirements of CPSC 16 CFR 1201

2-02: Types of Glass:

1) 1" insulating glass shall be equal to PPG Solarban 70 Clear Low E / Solexia + clear , in new aluminum exterior glazing systems with organic seal, composed of "clear lite plate glass, 1/2"air space, and interior 1/4" clear lite with interior coated plate glass. Visible light transmittance shall equal to 58%, with winter night time U-Value of .28, (Winter) and SHGC of 0.27. Glazing in exterior walls shall be tempered at areas adjacent to entrances, below 5 feet above finish floor elevation, and at other locations where shown on drawings. (not needed on this project)

2) 1/4" thick , factory identified with glazing classification, clear tempered glass, equal to L.O.F., at interior glazed areas.

3) Spandrel Panel shall be 1/4" or 1" insulated glass panel shall be set in glazing pocket with adapters. Spandrel glass shall be OPACI-COAT-300 system / see drawings for locations. (not needed)

2-03: Glazing Compound, Tapes, and Gaskets: Glazing compound shall be an approved polysulfide or silicone compound. Tapes and gaskets shall be butyl or polybutylene. Compounds for Fire Rated Glazing System shall be as approved for specific product and rated in accord with assembly.

PART 3: EXECUTION

3-01: Installation of Glass: Glazing procedures shall conform to manufacturer's recommendations. Glazing operations shall be carried on only when temperature is 40 degrees F., or above. Surfaces of glass and metal members which retain glass shall be clean and dry. Glass shall be cut to provide adequate bite, with room for expansion and contraction and perimeter clearance sufficient to avoid point loading. Glass shall have edges clean cut and cushioned to prevent contact with hard materials during and after installation. At completion of work, glass shall be free of cracks, scratches, and other defects not permitted by specifications. Defective glass shall be removed and replaced with new glass at not cost to the Owner.

END OF SECTION

DIVISION 9

FINISHES

SECTION 092116: GYPSUM WALLBOARD

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment, and related services necessary to furnish and install gypsum wallboard for interior finish and backer-board substrate related accessories and specialties called for on drawings and specified herein. Metal studs are specified in Section 054000.

1-03: Examination of Adjacent Work: Areas in which drywall systems are to be installed shall be examined by Drywall Subcontractor; defects which should be corrected before installation of drywall materials shall be reported to General Contractor and Architect. Drywall materials shall not be installed until work of other trades is in compliance with applicable requirements of Appendix A of ANSI Standard A97.1. Installation of drywall components shall constitute acceptance of substrate material by Subcontractor.

1-04: Delivery and Storage of Materials: Materials shall be delivered in original packages, containers, or bundles bearing name of manufacturer and fire rating. All materials shall be kept dry by storing inside building under roof. Wallboard shall be neatly stacked flat, with care taken to prevent undue sagging, or damage to edges, ends or surfaces. Damaged materials will not be accepted.

1-05: Humidity and Temperature Control: Application of wallboard shall not begin until building has approached as closely as possible the moisture content it will reach in service. Ventilation shall be provided, if necessary, to maintain a uniform temperature range of 55 to 70 degrees F.

1-06: Substitutions: For purposes of establishing type and quality of materials required for work included in this section, manufacturer's names, types, patterns, etc., are used. Unless otherwise noted, all product numbers/names in this section refer to United States Gypsum products. Equal products of other manufacturers will be acceptable, provided that requests for substitutions are accompanied by supporting technical literature, samples, and performance data for comparative evaluation 10 days prior to receipt of Bids. Manufacturers approved for use include:

United States Gypsum Co.
National Gypsum Co.
Georgia Pacific

PART 2: PRODUCTS

2-01: Cold Rolled Channels and Hanger Wire: Carrying channels shall be painted cold-rolled steel 1-1/2"x9/16"x0.0653" (16 gauge) thickness tied back-to-back with 18 SWG galvanized steel wire 48" o.c. and suspended with 12 SWG galvanized steel wire to joist lower chords or around beams at 48" o.c. max. at each end. Furring channels for lath attachment shall be 3/4"x1/2"x0.0635 (16 gauge) thickness spaced 16" o.c. and tied to carrying channels with 18 SWG wire at 48" o.c. max. and at each end. Extend carrying channels to within 6" of wall surface and furring channels to approximately 1" from wall surface. Splice furring channels with minimum 24"1. channel back-to-back with 18 SWG wire wrapped at ends and each side of splice. Where light fixtures or other openings occur, box out opening with carrying channels and suspend corners and mid-points of opening with 12 SWG wire to structure at distance not to exceed 48" o.c.

2-02: Metal Trim Moulding: Minimum 0.0336" thick (22 gauge) galvanized steel moulding equal to USG no. 402 (5/8" & 1 1/8" legs) around openings and secured to carrying channels with 1" Type S drywall fasteners. Spacing of fasteners approximately 8" o.c. along dimension and 10" o.c. along short dimension of opening.

2-03: Wall Angle: Minimum 0.0217" thick (26 gauge) galvanized steel angle with 1-1/4" legs, secured to walls along perimeter of ceiling to support steel framing member ends and for attachment of lath or drywall.

2-04: Gypsum Wallboard: All wallboard shall comply with requirements of ASTM C36 and bear UL Classification Marking and shall be 48" wide and of greatest practicable lengths for reduced number of joints; thickness shall be 5/8" throughout, unless otherwise listed on drawings

a) Wallboard for interior partitions, ceilings soffits and furred walls shall be equal to U.S. Gypsum Co., SHEETROCK® Brand Mold Tough® ULTRACODE® Gypsum Panels , or equal to Gold Bond® BRAND XP® Gypsum Board with Sporgard™* and meeting UL Classification, where indicated

b) Wallboard for interior use at areas of high humidity noted shall be U.S. Gypsum's Firecode "C" Exterior Gypsum Ceiling Board, moisture and mold-resistant drywall, as indicated on drawings.

c) Wallboard for use in Toilets, Janitor Space, Mechanical Rooms or other high humidity areas shall be equal to USG 5/8 " Th. "Humitek" gypsum panels with UL Classification.

d) USG Vinyl-faced Gypsum panels 5/8" thick, Firecode core shall be used as indicated on drawings.

2-05: Cement Board: Ceramic tile backup on all wall surfaces shall be equal to USG Durock Interior Tile Backer Board, 1/2" thick x 36" w. x longest practicable lengths. Board is composed of aggregated Portland cement with woven glass-fiber mesh embedded in back and front surfaces.

2-06: Trim Accessories:

a) Corner reinforcement: USG "Dur-A-Bead" heavy gauge No. 103.
b) Metal Trim: Interior - USG No. 200-A; Exterior - USG No. 402 metal.
c) Control Joints: USG No. 093, interior and exterior, where applicable.

2-07: Fasteners:

a) Wallboard to Steel Framing - 1" , and 1 5/8" Type S Buglehead
b) Wood Trim over Wallboard to Steel Framing - 1-5/8" Type S or S-12 Trim Head.
c) Cement Board to Steel Framing - 1-5/8" Durock steel screws.
d) Wallboard to Wood Framing - 1 1/4" Type W Buglehead
e) Gypsum sheathing to steel studs - 1" and 1 5/8" Type S-12

2-08: Joint Treatment – Interior:

a) Wallboard: USG Perf-A-Tape. & as req. by manufacturer for areas requiring Humitek or equal moisture resistant gypsum panels.

b) Cement Board: Durock Type P Tape.

c) Joint Compounds: First Coat (embedding tape, over beads, spotting fasteners) - USG Compound Taping. At cement board, use basecoat for thin-set application - see Section 093000, Ceramic Tile.
Second Coat (filling over tape, beads, and fasteners) - USG Ready-Mixed Compound Topping.
Third Coat (finishing over tape, beads, and fasteners) - USG Ready-Mixed Compound Topping.

2-09: Shaft Wall (1-Hour UL 415):

- 5/8" sheetrock fire code core gypsum panels, joints finished.
- 2-1/2" USG C-H studs 25-gauge 24" o.c.
- 1" sheetrock gypsum liner panel.

PART 3: EXECUTION

3-01: General: Work specified in this section shall be performed by personnel experienced and skilled in erection and finishing of drywall components.

3-02: Installation of Drywall Ceiling: Install wallboard with long dimension perpendicular to metal framing with side joints centered along runner. Fasten wallboard to framing channels with 1" long drywall fasteners at 12" o.c. along end joints, 8" o.c. along side joints, and 12" o.c. at intermediate framing. End joints of adjacent wallboard sheets shall be staggered not less than 48" o.c. with adjacent panels. Secure wallboard sheets to leg of wall angle with fasteners spaced 8" o.c.

3-03: Installation of Interior Gypsum Board: Panels shall be installed face out with long dimension perpendicular to furring channels or, if vertical, with edges over furring channels or studs. Edges and ends shall be fitted closely, but not forced together. Maximum practical lengths of wallboard shall be used; units shall not be "placed" at door frames. Joints shall be staggered on opposite sides of partitions. Cutouts shall be neatly made at outlets, switch boxes, etc. Screws shall be 1" long, spaced a maximum of 8" o.c. along abutting edges and 12" o.c. at ends, and 12" O.C. at intermediate framing. Distances of screws from edges or ends of panels shall be not less than 3/8". Dimples shall be not over 1/32" deep; face paper shall not be broken. Screws shall be installed with electric screw gun.

3-04: Cement Board Installation: Follow similar methods as wallboard except that fastening of boards to metal framing shall be with screws spaced 6" o.c.

3-05: Taping and Finishing: Finish at exposed areas shall be GA 214-90 Level 4 with entire surface skim coating or Level 3 at areas that are concealed above ceilings only. Apply a thin uniform layer of compound to joints and angles to be reinforced. Immediately apply tape, center over joints and seat into compound. Provide sufficient compound under tape approximately 1/64" to 1/32" for proper bond. Apply skim coat immediately following tape embedment. Fold tape and embed in angles to provide true angle. Allow to harden prior to application of fill coat. Apply compound over taping skim coat. Fill board, taper flush with surface. On non-tapered joints, apply compound over tape and feather out at least 4" on either side of joint. Do not apply filling coat to interior angles. Apply compound evenly over and extending slightly beyond fill coat on all joints. Feather to a smooth, uniform finish. Over tapered edges, finished joint shall not protrude beyond plane of surface. Apply compound at taped angles to provide a true angle. Fastener depressions shall have a minimum of three coats of compound; each coat shall be allowed to dry or harden before succeeding coat is applied. Each coat shall be feathered out from ground to plane of adjacent surface, each slightly beyond preceding coat. Sanding of compound, to provide flat, smooth surface acceptable for application of finish specified.

END OF SECTION

SECTION 096500: RESILIENT FLOORING

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment and related services necessary to furnish and install resilient flooring and base, with related accessories and specialties, as called for on Drawings (Finish Schedule) and specified herein.

1-03: Substitutions: For purposes of establishing type and quality of materials required for work in this section, names of manufacturers and brand names are used. Products of other manufacturers will be considered provided that requests for substitutions are accompanied by supporting technical literature, samples and performance data for comparative evaluation 10 days prior to receipt of Bids.
Manufacturers approved for this project:

Luxury Vinyl Tile Equal to
JJ Flooring
Make Your Mark Series
V502 Color

Rubber Base Equal to
Johnsonite / Color Charcoal #20

Seamless Vinyl Sheet Flooring (not used on this project)
Armstrong
Azrock Industries Inc.
Mannington Commercial
Tarkett

1-04: Submittals: Submit samples of flooring materials for Architect and Owner's approval of patterns and colors. Submit layout of patterned flooring showing sizes, edge conditions and transitions to non-patterned areas.

1-05: Examination of Surfaces: General Contractor and Flooring Subcontractor shall inspect work of other trades which affects work specified herein prior to installation. Flooring Subcontractor shall be responsible for checking concrete slabs and testing for moisture content to determine if surfaces are satisfactory for installation of resilient materials. Flooring Subcontractor shall verify with General Contractor type of curing agent used in concrete finishing to assure compatibility with adhesive. Where material is to be installed over plywood sub floor, Flooring Subcontractor shall check for level conditions, tight flush joints with no protruding conditions, adequate support at corner joints, adequate moisture content and all indentations filled with no protruding surfaces which might cause telegraphing in resilient surface. Defect or unacceptable surfaces shall be reported to General Contractor for correction and to Architect in writing prior to installation. Beginning installation shall be considered as acceptance of work of other trades and assumption of responsibility by Flooring Subcontractor for finished product.

1-06: Replacement Materials: Provide two boxes of each type, color, pattern, and thickness of tile and base used, one roll of each type of sheet vinyl used (in addition to scrap material larger than 24"x48") and factory-sealed container (1 gal. minimum) of adhesive used in applying vinyl base.

1-07: Storage and Temperatures: Materials shall be packed, stored and handled carefully to prevent damage. Temperatures shall be maintained at 70F minimum of 48 hours before, during, and for one week after installation. A minimum temperature of 55 degrees F. shall be maintained thereafter.

PART 2: PRODUCTS

2-01: Luxury Vinyl Tile:

Flooring shall be by JJ Flooring / Make Your Mark Series / V502 Color

2-02: Base: rubber cove base equal to Johnsonite Color Charcoal #20. Base to be 4" x 1/8" standard toe base. **Provide manufactured outside corners at all locations**. Corners to match base in color and profile.

PART 3: EXECUTION

3-01: Preparation: Where resilient flooring is scheduled, irregularities in the concrete slabs which might "telegraph" through finish materials shall be removed. Small depressions shall be filled with approved underlayment. Slabs shall be smooth, dry, free of dirt, oil, grease, incompatible curing compounds, or other material which might prevent satisfactory bonding of adhesives. At recreational sheet vinyl floors all joints in plywood finish layer shall be flush and tight except at perimeter where 1/2" min. expansion joint must be left.

3-02: LVT Flooring Installation: Flooring shall be installed in accordance with the manufacturer's latest printed instruction; 2 copies of these instructions shall be furnished to Architect

SECTION 096800: CARPETING

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplemental Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment, and related services required to furnish and install carpeting, with related accessories and specialties as scheduled in Drawings.

1-03: Substitutions: For purposes of establishing type and quality of materials required for work included in this section, manufacturer's names and brand names are used. Equal products of other manufacturers will be acceptable, provided that requests for substitutions are accompanied by supporting technical literature, samples, drawings, and performance data for comparative evaluation 10 days prior to receipt of Bids.

1-04: Submittals: Submit electronic copies of seaming diagrams to Architect for review before installing carpet. Use following criteria for diagram preparation:

1) Carpet widths to provide minimum number of seams.
2) Consistency of direction of pile.
3) Ease of future replacement.
4) Avoidance of seams at or perpendicular to openings.

Submit electronic copies of following data:

1) Specific listing of manufacturer and mill, exact color, name, number and fiber (for use in reordering).

2) Manufacturer's recommendations for type of adhesive to be used with specified carpet, recommended tests for excessive moisture or alkalinity in concrete and proper installation procedures.

1-05: Certification: General Contractor to furnish certificate provided by carpet manufacturer stating that carpet identified by register number called for in Para. 1-07 was manufactured in accordance with these specifications.

1-06: Applicable Specifications and Standards: Methods of tests to be used shall be those applicable and reported in ASTM "Standards on Textile Materials" prepared by ASTM Committee D-13 and published by the American Society for Testing and Materials. Major method shall be ASTM D418, "Methods for Testing Woven and Tufted Pile Floor Coverings". Testing for such characteristics as flame spread, seam strength, shrinkage, and moth repellence shall be in accordance with testing procedures and end limits (for shrinkage) described in ASTM E-84 and DDD-C-95. Manufacturer's Certification for carpet materials shall comply with "Use of Materials Bulletin UM-44C" published by US Department of Housing and Urban Development and are currently listed in HUD "Certified Products Directory" and so identified by imprint on back of carpet. In addition to the methods of sampling described in the foregoing test procedures, samples can be taken from unused material on the job site, distributor's or retailer's as well as manufacturer's stock of certified materials.

1-07: Delivery and Storage: Carpet shall be delivered to the site in original mill wrappings with each roll having register number tags attached, or register number stenciled on wrapping and intact. Storage areas shall be dry, well ventilated, and heated if required to prevent shrinking or stretching. Carpet shall be protected against damage, dirt, stains, and moisture.

1-08: Inspection of Surfaces: Floor construction and surfaces to receive carpeting shall be inspected and tested for moisture content by carpet installer who shall promptly notify General Contractor and Architect in writing of substrate defects having adverse effect on quality of installation. Proceeding with work shall constitute acceptance of subfloor surface condition and responsibility by carpet installer for finished product. Floor areas to receive carpet shall be smooth, vacuum clean and dry prior to installation of carpeting. Floor temperature must be minimum of 65 degrees F. for 72 hours prior to installation and tested for excessive moisture or alkalinity by carpet installer. Should tests reveal excessive moisture or alkalinity, surfaces of concrete shall be sealed using material and application methods recommended by carpet manufacturer.

1-09: Replacement Materials: For replacement and repairs, Contractor shall furnish Owner with eight square yards of each type and color of carpet installed, from same dye lot as installed carpet. Replacement carpet remnants, usable scrap (2'x 2' min.) and maintenance instructions shall be packaged in appropriate wrapping, labeled and left with Owner.

1-10: Guarantee/Warranty: Upon completion of installation, the carpet manufacturer must submit a certificate guaranteeing carpet against material and workmanship defects for a period of 1 year from date Certificate of Compliance is received by General Contractor. Manufacturer shall furnish to Owner a standard warranty for 10 years.

PART 2: PRODUCTS

2-01: Carpet:

Collection: Carpet 1+2 Interface Rising Signs Collection
Color: Carpet 1 Binary Code 107217 Oxygen / Carpet 2 Binary Code 107221 Carbon

Product Type: Tile

2-02: Physical Requirements:

Const. Type – Tufted Textured Loop
Gauge – 1/12 (47.20 rows per 10 cm)
Pile Density – 8,143 oz/yd^3
Sustainable Content – Contains 58% pre-consumer recycled content and 10% post-consumer content by total weight
Stitches per inch – 8.1 /in (31.9 per 10 cm)
Finished Pile Thickness - .084" (2.10 mm)
Dye Method – Solution Dyed
Backing Material – EcoFlex NXT
Yarn System – 100% Recycled Content Nylon
Yarn Manufacturer – Aquafil
Tufted Yarn Weight – 19 oz/yd^2 (644 g/m^2)
Pattern Repeat – Not Applicable
Size / Width – 25cm x 1m
Soil/Stain Protection – Protekt^2®
Installation Method – Ashlar, Herringbone
Indoor Air Quality – Green Label Plus #GLP0820 - CDPH 01350
Foot Traffic Classification: Heavy
NSF/ANSI 140 Gold

2-03: Performance:

Static – AATCC-134 Under 3.0 KV
Flammability – Passes Methenamine Pill Test (DOC-FF1-70)
Smoke Density – ASTM E 662 Less than 450
Flooring Radiant Panel – Passes ASTM E-648

Service:

Warranties - 15 Year Standard Carpet Warranty

2-04: Ancillary Materials:

a) Concrete floor sealer, adhesive, cleaning solutions shall be chemically compatible with subfloor and carpet materials, and shall conform to manufacturer's recommendations. Flammability rating of adhesive material shall not exceed the flame spread specified above for carpet. Adhesives shall be environmentally safe and low odor type.

b) Solid vinyl edge strips, trim, molding, and transition strips shall be submitted to Architect for approval.

PART 3: EXECUTION

3-01: General: The work shall be done by personnel fully experienced in carpet installation. Carpet shall not be installed until the building is enclosed, permanent heating and cooling systems are in operation and residual moisture from plaster, concrete, or terrazzo work has dissipated. Carpet installer shall conduct moisture test of surfaces to receive carpet and be satisfied that surface meets moisture criteria, prior to installation. Carpet shall be installed by the direct glue-down method in accordance with manufacturer's recommendations for seaming technique and for proper amount of stretch in width and length. Each color to be installed shall be from same dye lot.
Carpet shall be cut in the longest lengths possible to eliminate unnecessary cross seams. Cut sections for each area shall be fitted into place before any adhesive is applied.

3-02: Installation: Adhesive shall be thoroughly stirred and evenly applied. Coverage shall be not more than 20 square yards per gallon; there shall be a minimum of 90% bond of carpet to slab. Seams shall be made by the compression method; stripping or plugging will not be accepted. Seams shall be trimmed and fitted neatly and shall be bonded with Roberts Seam Adhesive No. 41-4015 or approved equal material; adhesive shall be applied to cut edges of carpet at the level of carpet backing. Adhesive shall be submitted to Architect for approval. Saddles or "T"- Seams shall not be used in doorways. Carpet surface shall be rolled down to expel any air bubbles. Installer will be required to re-lay any carpet that does not provide wrinkle-free appearance and shall correct any condition due to faulty installation, which may appear for a period of one year from the date of the completed installation. Edge strips, of approved materials and design, shall be installed where floor covering materials change or where exposed edges occur. Installed carpet shall be clean, free of spots, dirt or soil, and shall be without tears, frayed or pulled tufts.

END OF SECTION

SECTION 098000: ACOUSTICAL TREATMENT

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment, and related services necessary to furnish and install suspended acoustical ceilings and acoustical panels as called for by Drawings and Finish Schedule, and as specified herein.

1-03: Substitutions: In order to establish type and quality of materials required for work under this section, manufacturer's names and brand names are used. Equal products of other manufacturers will be acceptable provided that requests for substitutions are accompanied by supporting technical literature, samples, details and performance data for comparative evaluation 10 days prior to receipt of Bids. Manufacturers approved for this project include:

a) Acoustical ceilings — Armstrong
Celotex Corp.
USG Interiors

1-04: Coordination: Work included in this section shall be coordinated with work of mechanical and electrical trades for ceiling / wall fixtures, switches, receptacles, etc., and installation of contiguous drywall ceilings.

1-05: Samples: Submit samples as follows:

a) Acoustical material - 1-12"x12" piece of each type.
b) Runners and cross tees: 1 each, approximately 12" long.
c) Wall moulding: 1 piece approximately 12" long.
d) Acoustical wall material: 1-12"x12" piece and color samples of fabric coverings.

1-06: Standards: Acoustical treatment shall be installed under conditions outlined in the Acoustical and Insulating Materials Association's Bulletin under "Job Conditions".

1-07: Quality Standards: Acoustical Subcontractor shall examine building before beginning work specified herein to determine if space is complete enough to receive installation. Report improper conditions to General Contractor and Architect; do not proceed with work until proper conditions are achieved. Installing material shall constitute acceptance of substrate conditions.

PART 2: PRODUCTS

2-01: Suspended Acoustical Ceiling:

a) Suspension system shall be exposed grid hung from structure (bar joists and steel beams) by means of galvanized wire not lighter than 12-gauge. Framing shall be of electrogalvanized steel with baked on polyester paint finish. Color to be selected from manufacturer's standards. Matching wall mouldings shall be provided. Framing shall comply with ASTM C635 requirements for Intermediate Duty systems. System to be equal to Armstrong Prelude XL Fire Guard. Suspension system perimeter wall trim shape is indicated on drawings for special conditions. Wall trim shall be equal to Armstrong No. 7871 "Shadow Moulding" reveal type. Acoustical tile to be Armstrong No. 3151Optima Tegular fine texture 24"x24"x3/4"panels.

2-02 Altispace Acoustical Blades and Shapes

A) Acoustic Blades shall be 12"tall x 96"long x 2-3"thick. Panels to have Class A fire rating and be suspended by aircraft cable. Colors to be chosen from manufacturer's standard colors.

B) Illuminated Acoustic Blades shall be 12"tall x 96"long x 2-3" thick. Panels to have Class A fire rating and be suspended by aircraft cable. Lights to have 3500 kelvin rating, supplied by GC and connected by electrician. Other Approved suppliers for items A+B are Acoufelt Truss Ceiling baffels series, Frasch BAFL Classic series and Focal Point Seem 1 Acoustic Blade and LIT system.

C) Acoustic Shapes shall be 2" thick x 36"x36" hexagons. Panels to have Class A fire rating and be suspended by aircraft cable.

PART 3: EXECUTION

3-01: General: Acoustical materials and suspension systems shall be installed by experienced subcontractor for types of work involved. Installation of acoustical ceilings panels and baffles shall not begin until building is enclosed and heat is provided so that residual moisture from other trades is dissipated.

3-02: Acoustical Ceiling: Ceilings shall be installed in accordance with patterns indicated on Reflected Ceiling Plan. Suspension system shall be installed in accordance with the requirements of ASTM C636, “Recommended Practice for Installation of Metal Ceiling Suspension System for Acoustical Tile and Lay-in Panels” and manufacturer’s recommendations. Acoustical panels shall be installed in accordance with the recommendations of the Acoustical and Insulating Materials Association, contained in the current AIMA Bulletin. Units shall be of the greatest possible size. Members shall be aligned and leveled to provide true surfaces and straight lines. Provide tile in unopened boxes for replacing 100 sq.ft. minimum of each pattern type and leave with Owner.

3-03: Cleaning and Replacement: Before installation is accepted by Owner, ceiling units or panels which have been improperly installed, or which have been damaged, shall be removed and replaced. Discolored or soiled surfaces shall be cleaned in accordance with manufacturer’s recommendations.

END OF SECTION

SECTION 099000: PAINTING

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions of the Contract, Supplemental Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment, and related services necessary to provide and apply paints, sealers, and related materials called for by drawings and finish schedule and specified herein. In general, all exposed surfaces of factory and/or shop primed work that is delivered to job site without final finish, shall be painted under this section by the General Contractor. Exposed electrical, plumbing, and HVAC equipment in public spaces, excluding mechanical spaces to be painted by the respective trade, shall be painted by the General Contractor. Work covered by this section shall be coordinated with work of other trades; surfaces which are left unfinished by requirements of other sections of specifications shall be painted or otherwise finished as required in this section. Altered existing work or damaged surfaces that have been repaired shall be painted under this section. Finishes shall match existing adjacent surfaces.

1-03: Samples and Colors: Maximum number of different colors which will be used for interior painting will be eleven; not more than three different paint colors will be used in any one space. General Contractor shall obtain color selections from Architect for all types of work and shall prepare samples of each type and color for approval. Samples shall be applied to surfaces which represent surface to be painted; they shall have required number of coats and be treated and finished in same manner as completed work. In lieu of preparing sample panels to show finish and color, Contractor shall have option to prepare a room (complete or in part) to establish standard for workmanship and appearance of finish. See 1-05 below for additional information.

1-04: Storage and Protection: Materials to be used on project shall be stored in an area approved by Paint Suppliers and Architect. Storage spaces shall be protected against damage from spilled or carelessly handled materials and shall be safeguarded against fires. Used rags shall be kept in closed metal containers; paints and other liquids shall be kept covered. All stored materials shall be stored outside building in storage facility equipped to maintain temperatures above manufacturer's low temperature storage requirements or off site.

1-05: Environmental Conditions: Materials specified are assumed to be low or no VOC type coatings. Should manufacturer's specifications change, Architect shall be notified and appropriate coatings submitted for review and approval prior to acceptance for use at this facility. Surfaces to be painted shall be thoroughly dry and clean of any oils or material which will prohibit proper bonding of paint. Painting shall be done at temperatures recommended by manufacturer for air, humidity and surface to receive paint. Failure to comply with these recommendations shall be cause for rejection of work or repainting.
For interior work, temperature of spaces in which painting is being done, or where paint and finish are drying, shall be maintained above 60 degrees F.

1-06: Inspection of Surfaces: Surfaces to be finished under this section shall be examined before work is begun by Painting Subcontractor to determine if they are in condition to receive finish specified. Report improper conditions to General Contractor and to Architect in writing; work shall not proceed until proper substrate conditions have been obtained. Coatings scheduled to be applied to existing "painted surfaces" shall be tested for primer and finish coat compatibility and bond strength prior to application. No work shall be done to surfaces that fail the coating/bonding test prior to remedy of surface bonding as required by the coating manufacturer. Application of paint or other coating to any surface shall constitute acceptance of substrate conditions for that surface and responsibility for finished product. Note General Contractor will be responsible for getting existing walls ready for repainting.

1-07: Approval of Coating Applications: General Contractor shall report to Architect application of each coat on each surface painted or otherwise finished. After coat has been applied, it shall be inspected and approved by Architect before application of succeeding coat; failure to comply with this provision may result in Contractor's

being required to recoat any areas not so reported and approved; no additional compensation will be allowed for such recoating work.

PART 2: PRODUCTS

2-01: General: In order to establish type and quality of materials required for work covered by this section, manufacturer's names and brands are listed in Subsection 2-03, Approved Materials. Products of other manufacturers equal in quality and in suitability for the usage intended, will be acceptable provided that requests for substitutions shall be accompanied by supporting technical literature, samples, and performance data for comparative evaluation 10 days prior to receipt of Bids. Materials for which no brand names are listed, such as thinners, shellac, linseed oil, wood filler, and turpentine, shall be of highest quality and shall have identifying labels on containers. Materials shall be delivered to site in their original containers, seals intact, with labels to include manufacturer's name, product name and number, color code and batch number, undamaged. All finish coats shall constitute a system; i.e., primer shall be compatible with top coat as recommended by paint manufacturer. Wet mil and dry mil thickness range is only a guide for film thickness required; actual film thickness shall be as stated by approved manufacturer for type of paint used.

2-02: All paint products to be low V.O.C. Approved Manufacturers include:

Sherwin Williams
PPG
Coronado

2-03: Approved Materials (Note: (3) coats of paint will be required on all existing walls)

TYPE	NO. OF COATS	WET MIL RANGE	DRY MIL RANGE
Finish No. 1: Ferrous Metal - Interior			
Prime Coat:	1	4.0 - 5.0 W.M.	1.5 - 2.0 D.M.
Sherwin Williams Kem Kromik Universal Metal Primer B50 Series			
PPG Pitt-Tech Plus – 4020-PF / Devflex-4020-PF			
Coronado Rust Scat White Metal Primer 35-111			
Top Coats:	2	4.0 W.M. ea.	1.5 D.M. ea.
Sherwin Williams ProMar 200 Semi-gloss Enamel			
PPG Pitt-Tech Plus – 4216-HP / Devflex-4216-HP			
Coronado DTM Acrylic Semi-gloss 180 Series			
Finish No. 2: Galvanized Metal - Interior			
Prime Coat:	1	3.0 - 4.0 W.M.	1.4 - 2.0 D.M.
Sherwin Williams Galvite High Solids B50W230			
PPG Pitt-Tech Plus – 4020-PF / Devflex-4020-PF			
Coronado Perma-Bond Primer 100-10			
Top Coats:	2	4.0 W.M. ea.	1.5 D.M. ea.
Sherwin Williams ProMar 200 Latex Semi-gloss Enamel			
PPG Pitt-Tech Plus – 4216-HP / Devflex-4216-HP			
Coronado Acrylic Latex Semi-gloss Enamel 12 Series			
Finish No. 3: Concrete Block - Interior			
Prime Coat:	1	6.0 - 20.0 W.M.	4.0 - 10.0 D.M.
Sherwin Williams Prep-Rite Interior/Exterior Block Filler B25W25			
PPG Speedhide Interior / Exterior Masonry Latex Block Filler			
Coronado Superkote Latex Masonry Filler 946-11			

TYPE	NO. OF COATS	WET MIL RANGE	DRY MIL RANGE
Top Coats:	2	4.0 W.M. ea.	1.5 D.M. ea.

Sherwin Williams ProMar 200 Latex Semi-gloss Enamel
PPG Speedhide Zero Interior Latex
Coronado Acrylic Latex Semi-gloss Enamel 90 Series

Finish No. 4: Interior Concrete Block - Glazed Coating

Prime Coat:	1	6.0 - 20.0 W.M.	4.0 - 10.0 D.M.

Sherwin Williams Prep-Rite Interior/Exterior Block Filler B25W25
PPG Speedhide Interior / Exterior Masonry Latex Block Filler
Coronado Superkote Latex Masonry Filler 946-11

Top Coats:	2	3.6 - 9.0 W.M. ea.	2.0 - 6.0 D.M. ea.

Sherwin Williams Water Based Catalyzed Epoxy
PPG Aquapon WB EP Epoxy
Coronado Acrylic Epoxy 138 Line Series ,Semi-Gloss

Finish No. 5: Gypsum Board/Plaster - Glazed Coating

Prime Coat:	1	4.0 W.M.	1.5 D.M.

Sherwin Williams Prep-Rite 200 Latex Primer B23W200
PPG Speedhide Interior Latex Quick Dry Sealer
Coronado Superkote Latex Masonry Filler 946-11

Top Coats:	2	3.6 - 9.0 W.M. ea.	2.0 - 6.0 D.M. ea.

Sherwin Williams Water Based Catalyzed Epoxy
PPG Aquapon WB EP Epoxy
Coronado Acrylic Epoxy 138 Series

Finish No. 6: Gypsum Board/Plaster - Wall partitions

Prime Coat:	1	4.3 W.M.	1.1 D.M.

Sherwin Williams Prep-Rite 200 Latex Primer B23W200
PPG Speedhide Interior Latex Quick Dry Sealer
Coronado Super Coat Latex Primer-sealer 40-11

Top Coats:	2	4.0 W.M. ea.	1.5 D.M. ea.

Sherwin Williams ProMAr 200 Latex Semi-gloss Enamel
PPG Speedhide Zero Interior Latex Semi-Gloss Paint
Coronado Latex Semi-gloss Enamel 90 Series

Finish No. 7: Gypsum Board/Plaster - Interior Ceilings, Furred Soffits & Fascia Areas

Prime Coat:	1	4.3 W.M.	1.1 D.M.

Sherwin Williams Prep-Rite 200 Latex Primer B23W200
PPG Speedhide Interior Latex Quick Dry Sealer
Coronado Super Coat Latex Primer-sealer 40-11

Top Coats:	2	3.0 W.M. ea.	1.2 D.M. ea.

Sherwin Williams ProMar 200 Latex Flat Wall Paint
PPG Speedhide Zero Interior Latex Flat Paint
Coronado Flatwalls Flat Latex 24 Series

TYPE	NO. OF COATS	WET MIL RANGE	DRY MIL RANGE

Finish No. 8: Moisture Resistant Gypsum Board

Prime Coat: 1 3.2 - 4.0 W.M. 1.7 D.M.
Sherwin Williams Prep-Rite 200 Latex Primer B23W200
PPG Speedhide Interior Latex Quick Dry Sealer
Coronado Super Coat Latex Primer-sealer 40-11

Top Coats: 2 9.5 W.M. ea. 6.0 D.M. ea. Sherwin Williams Tile-Clad II High Solids Epoxy
PPG Aquapon WB EP Epoxy Semi-Gloss
Coronado Acrylic Epoxy Enamel

Finish No. 9: Interior Wood - Painted

Prime Coat: 1 3.1 W.M. 1.5 D.M.
Sherwin Williams Prep-Rite VOC-Complying Wall and Wood Primer B49WZ2
PPG Seal Grip Interior / Exterior Universal Primer Sealer
Coronado Alkyd Enamel Undercoat 37-11

Top Coats: 2 4.0 W.M. ea. 1.5 D.M. ea.
Sherwin Williams ProMar 200 Latex Semi-gloss Enamel
PPG Speedhide Zero Interior Latex Semi-Gloss Paint
Coronado Acrylic Semi-gloss Enamel 90 Series

Finish No. 10: Interior Wood - Natural Finish

Prime Coat: Tint , as selected, with oil stain; fill voids with wood filler paste
Sherwin Williams Natural Wood Filler D7051
PPG Deft Interior Water-Based Sanding Sealer
Coronado Sanding Sealer 67-11

Top Coats: 2 3.3 W.M. ea.
Sherwin Williams Waterborne Polyurethane Varnish A68 Series
PPG Deft Interior Water-Based Polyurethane Acrylic / Satin Finish
Coronado Polyurethane 67-100

Finish No. 11: Interior Concrete Floors

Prime Coat: (Thin 20%) 1 W.M. 1.5 D.M.
Sherwin Williams Armour Tread-Flex WB Acrylic Floor Coating Primer B90W100
PPG Aquapon WB EP Epoxy
Coronado Polyurethane Floor Finish 1231 Series

Top Coats: 1 or 2 (as required) 10.0 W.M. 1.5 D.M.
Sherwin Williams Armour Tread-Flex WB Acrylic Floor Coating B90W100
PPG Aquapon WB EP Epoxy

Finish No. 11a: Interior Concrete Floors, Mechanical / Storage other Utility Areas-Transparent Sealer

Prime Coat: (Thin 20%) 1 W.M. 1.5 D.M.

1. PPG Aquapon WB EP Epoxy
2. Coronado Polyurethane Floor Finish 63 series
3. Sherwin Williams Concrete and Terrazzo Sealer

Top Coats: 2 W.M. 1.5 D.M. ea.

1. PPG Aquapon WB EP Epoxy
2. Coronado Polyurethane Floor Finish 63 series
3. Sherwin Williams Industrial Enamel

TYPE	NO. OF COATS	WET MIL RANGE	DRY MIL RANGE

Finish No. 12: Ferrous Metal - Exterior

Prime Coat	1	4.0-5.0 W.M.	1.5-2.0 D.M.

1. Glidden Glid-Guard Alkyd Metal Primer No. 4570
2. Sherwin Williams Kem Kromik Metal Primer
3. Coronado Rust Scat White Metal Primer 35-111
4. PPG Multi-Prime 4160 / Devguard 4160

Top Coats:	2	4.5 - 5.5 W.M. ea.	2.0 - 2.5 D.M. ea.

1. Glidden Glid-Guard Alkyd Industrial Enamel No. 4550
2. Sherwin Williams Industrial Enamel Gloss B54
3. Coronado Urethane Alkyd Enamel Series M 31
4. PPG HPC Industrial Alkyd 4308 / Devguard 4308

Finish No. 13: Galvanized Metal - Exterior

Prime Coat:	1	3.0 - 4.0 W.M.	1.5 - 2.0 D.M.

1. Glidden Glid-Guard All Purpose Metal Primer No. 5229
2. Sherwin Williams Galvite Primer
3. Coronado Perma-Bond Primer 100-10
4. PPG Multi-Prime 4160 / Devguard 4160

Top Coats:	2	4.5 - 5.5 W.M. ea.	2.0 - 2.5 D.M. ea.

1. Glidden Glid-Guard Alkyd Industrial Enamel No. 4550
2. Coronado Urethane Alkyd Enamel Series M31
3. Sherwin Williams Industrial Enamel Gloss B54
4. PPG HPC Industrial Alkyd 4308 / Devguard 4308

Finish No. 14: Painted Wood - Exterior

Prime Coat:	1	3.6 - 4.6 W.M.	2.2 D.M.

1. Glidden Prime Coat Oil/Alkyd No. 3651
2. Sherwin Williams a-100 Exterior Oil Wood Primer
3. Coronado Oil House Paint Primer 9-11
4. PPG Seal Grip Interior / Exterior Universal Alkyd Primer Sealer

Top Coats:	2	4.5 W.M. ea.	2.5 D.M. ea.

1. Glidden Spred Gel-Flo House & Trim Paint No. 1901
2. Sherwin Williams Pro Mar Alkyd Flat Exterior B38W
3. Coronado Flat OIl House Paint 7 series
4. PPG Speedhide Interior / Exterior WB Alkyd

Finish No. 15: Existing Exterior Masonry and Concrete Panel System

Preparation: Scrape, sand and power wash (min 2100 psi) and allow to dry, Repair racks, voids and other penetrations with coating product manufacturer's patching material and / or sealants. Remove existing mildew with approved method prior to application of primer.

Prime Coat:	1	8.0 W.M.,	3.2 D.M.

1. PPG Perma-Crete Concrete and Stucco Primer
2. Coronado Masonry Sealer 48-11
3. Sherwin Williams Loxon Masonry Coatings

Masonry Filler as Required:	1 Coat	5.0 W.M.	8.2-16.4 D.M

1. Sherwin Williams Prep-Rite Interior/Exterior Block Filler B25W25
2. PPG Speedhide Interior /' Exterior Masonry Latex Block Filler
3. Coronado Superkote Latex Masonry Filler 946-11

TYPE	NO. OF COATS	WET MIL RANGE	DRY MIL RANGE
Top Coats:	1 or 2	10.0 W.M.	1.6 D.M. ea

1. PPG Speedhide Exterior Latex Semi-Gloss
2. Coronado 138 series Epoxy Enamel
3. Sherwin Williams A-100 Exterior Paint Coating

2-03: Mechanical and Electrical Equipment: Items in Division 23 and 26 that require painting are to be executed under those contracts. Prime and finish coats applied to those items are specified in Paragraph 2-02. Painting including but not limited to following items are covered by this Section and shall be the responsibility of respective trades of those Divisions to provide required paint finish:

Exposed steel piping
Copper piping
Cast iron piping
Insulated piping
Electrical conduit
Fittings
Ducts
Hangers
Supports

These items shall be primed as specified for their material and shall be painted to color of particular surfaces against which they occur unless directed otherwise by Architect or specified in Color Schedule.

PART 3: EXECUTION

3-01: Preparation of Surfaces:

1) Surfaces to be finished shall be free of imperfections or contamination which would interfere with uniform appearance, adhesion and quality of coating. Contractor shall clean all existing walls of tape, stickers or other items that have been adhered to existing walls before beginning painting operations.

2) Ferrous metal surfaces, excluding stainless steel surfaces, that will be exposed in complete work shall be prepared in accordance with SSCP-SP3, Power Tool Cleaning, for normal requirements, or SSCP-SP6, Commercial Blast Cleaning, for when prolonged job site exposure occurs, prior to placement of primer coat.

3) Galvanized steel surfaces shall be prepared in accordance with SSCP-SP1, Solvent Cleaning, prior to placement of primer coat.

4) Wood surfaces shall be sanded smooth and dust removed before application of any coating. Knots or sap spots shall be sealed with 2-pound cut shellac prior to application of prime coat. Nail holes shall be puttied or filled with plastic wood after priming or undercoating is applied, then sanded smooth; wood filler shall match color of finish where clear coats of finish are specified.

5) Abraded areas of shop coats shall be primed.

6) Concrete Floors

a) Unpainted floors - Acid etch or detergent removal of contaminants as per manufacture's recommendations

b) Previously painted floors - Sand blast or Detergent/power wash removal of existing pain/contaminants as recommended by the manufacturer

3-02: Application:

1) Methods

Materials may be applied to surfaces of large area by brush, roller or spray, provided that final coating has solid hiding and uniform appearance. Brush applied coatings shall be brushed out uniformly, to eliminate laps, skips, and excess brush marks. Cutting in with brush on surfaces adjoining roller or spray coated areas shall be done carefully so that finish will be of the same texture, color, and hiding as adjacent areas. Roller coated areas shall show no signs of lapping or excess paint lines from edges of roller. Spray painting shall be done prior to installation of fixtures, hardware, flooring, and other finish items, unless all such items are thoroughly protected. Spraying equipment shall be suitable in type and of adequate capacity for experienced painters, to assure a uniform finish of acceptable quality. Methods of application, including adherence to spreading rate listed by the

approved paint manufacturer to obtain recommended dry mil thickness, time lapse between successive coats, etc., shall be in accordance with manufacturer's recommendations.

2) Mixing and Tinting

Job site tinting of finish coats shall be done only with the approval of the Architect. Primer, undercoating, and intermediate coats shall each be visibly different in color from preceding coats. Tinted colors are to be of the type recommended by the manufacturer of the coatings approved for use on the project.

Thinning shall be done only when specifically permitted by the manufacturer; if permitted, it shall be done with the materials and to the extent recommended by the manufacturer; wit mil thickness shall be increased to provide manufacturer's recommended dry mil thickness.

3) Final Coatings

Finished work shall show no runs, sags, curtains, excessive brush marks, holidays, or other evidence of poor applications. Spot painting to correct soiled or damaged paint surfaces shall be blended into surrounding finish so that it will not be visible to normal viewing; if it is not, entire sections shall be re-coated between corners or other approved stopping points. Edges of paint adjoining other materials or colors shall be sharp and clean, without overlapping. Sanding between coats, with fine sandpaper, shall be done as required to achieve even, smooth finish on wood and metal surfaces. Should the number of coats specified to be applied to surfaces herein listed not cover, additional coats shall be applied until a satisfactory finish is produced.

3-03: Protection and Cleaning:

Adjacent work and materials shall be protected with suitable covers during painting and finishing operations. Splatters or spills of paint or other coatings on floors, adjacent coatings, glass, and other finished surfaces shall be carefully removed.

END OF SECTION

DIVISION 10

SPECIALTIES

SECTION 102800: TOILET AND BATH ACCESSORIES

PART 1: GENERAL

1-01: Reference to Other Documents: The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: Work Included: This section includes labor, materials, equipment and related services necessary to furnish and install toilet and bath accessories, with related specialties, called for by drawings and specified herein.

1-03: Substitutions: For purposes of establishing type and quality of materials required for work included in this section, manufacturer's names, types, patterns, etc., are used. Equal products of other manufacturers will be considered provided that requests for substitutions are accompanied by supporting technical literature, samples, and performance data for comparative evaluation 10 days prior to receipt of Bids. Products approved for use:

BRADLEY, Charlotte, NC (704.543.7053)
BOBRICK, Charlotte, NC (704.545.4545)
McKINNEY, Scranton PA (717.346.7551)

PART 2: PRODUCTS

2-01: Men and Women's Toilets:

A) Stainless Steel Grab Bars:
- Bobrick B-6206 x 42" 1 at each toilet.
- Bobrick B-6206 x 36" 1 at each toilet.
- Bobrick B-6206 x 18" 1 at each toilet.

B) Steel Channel Framed Mirror:
- Bobrick B 165 – 36" x 24" 1 at each toilet.

C) Toilet Tissue Dispensers:
- Bobrick B6699 surface mounted single roll unit 1 at each toilet.

D) Paper Towel Dispensers and Waste Receptacle:
- Bobrick B369 – 1 at each toilet.

E) Soap Dispenser:
- Bobrick B2112 surface mounted soap dispenser – 1 in each toilet.

PART 3: EXECUTION

The exact location of accessories will be determined on site. They shall be set in proper relationship with wall finishes, anchored securely to blocking or masonry as required, erected level and square without damaging accessories or finished surface. Mountings shall be concealed, generally. Toilet tissue dispensers shall be attached to metal stud walls with 1/8" toggle bolts. Grab bars shall be attached with anchors or mounting kits scheduled, with anchor plates concealed. Grab bar mountings shall meet requirements of N.C. State Building Code, i.e., that they support a 250 pound load. All exposed screws, nuts, washers, etc., used in mounting devices or accessories shall be of brass, chromium-plated; of stainless steel; or of other non-corroding material as approved on shop drawings.

END OF SECTION 102800

DIVISION 12

FURNISHINGS

SECTION 122000: WINDOW TREATMENT - BLINDS & SHADING DEVICES

PART 1: GENERAL

1-01: **Reference to Other Documents:** The General Conditions, Supplementary Conditions and Division 1 contain requirements relevant to work covered by this section.

1-02: **Work Included:** This section includes labor, materials, equipment and related services necessary to furnish and install operable window blinds at exterior windows in all rooms, at all interior window openings between rooms and corridor, between rooms and rooms, and at vision windows in specific door frames. (See door and frame schedule for door vision panels requiring blinds). Blinds shall be provided at clear glazed openings.

1-03: **Substitutions:** For purposes of establishing type and quality of materials required for work included in this section, manufacturer's names and brand names are used. Equal products of other manufacturers will be acceptable, provided that requests for substitutions are accompanied by supporting technical literature, samples, drawings, and performance data for comparative evaluation 10 days prior to receipt of Bids. Products approved for use include:

Levolor
Hunter Douglas
Bali

1-04: Shop Drawings: Submit electronic copies of shop drawings minimum for review before fabrication is begun. Drawings shall indicate sizes, and hardware installation details.

PART 2: PRODUCTS

2-01: General:

a. **Horizontal Blinds** shall be nominal 1" wide horizontal slats in assembly similar to Levolor Lorentzen, Inc., Riviera DustGuard Series. Slats shall be supported by braided ladders. Products of Bali Classic Mini-blinds are also approved for use.
Blinds will not be required for Shell Building

2-02: Horizontal Blind Construction and Finish:

a) Slats shall be 0.007" thick before painting, 0.008" after painting. Slats shall have a finish similar to "tomized" catalytic undercoat bonded to aluminum, and finished with baked enamel coat. Color of blinds (and other related accessories) shall be selected from standard color samples. Slats shall have an elliptical crown of proper contour formed after coating and curing. Radius of corners shall be 5/32". Note: "Tomized" treatment refers to corrosive resistive treatment on the metals. Other treatments of corrosive resisting finish shall be verified with the Architect.

b) Head channel shall be .025" "Tomized" steel with baked enamel finish coating. It shall be U-shaped, 1" high x 1-9/16" wide with flanged edges at top.

c) Tilter shall be .042" "Tomized" steel and shall have a wand of grooved plastic, which by turning shall adjust slats to desired angle.

d) Cord lock shall be .042" thick "Tomized" steel securely attached to head, crash proof type to snub cords without tearing and to lock slats at one height when cores are released.

e) All blinds shall have a cradle and drum for each ladder. Cradle shall be .042" "Tomized" steel and shall have holes with rolled edges to guide the ladder and cord through bottom of head. The drum shall be .031" thick "Tomized" steel and shall have 2 holes with rolled edges to anchor the barbs of each of the two ladders ends.

f) Tilt rod shall be of solid "Tomized" steel with sectional dimension of 1/4".

g) End braces of .042" thick "Tomized" steel shall be fastened at each end of head. Each brace shall have an adjustable tab.

h) Installation brackets of .042" thick shall be provided to support ends of head channel. Intermediate brackets shall be installed as required by manufacturer's recommendations according to unit size of blind.

i) Slab supports shall be braided of polyester yarn, the vertical component which shall be not less than .045 inch diameter, nor greater than .068 inch diameter for maximum strength. Braiding shall be accurate to hold slats at uniform parallel position for proper tilt control. There shall be 28 rungs per 2'-0" or ladder equally spaced at .788" intervals. Distance between ladders shall not exceed 21".

j) Bottom rail shall be of .031" "Tomized" steel, and shall be provided with pierced holds for the ladders and cord. Plastic caps shall lock onto rail to cover cord and ladder holds. End caps with bottom flange shall be provided.

k) Lift cord shall be of rayon core and braided with synthetic fibers, and shall have a minimum breaking strength of 200 pounds. Cord ends shall be securely anchored to bottom rail at maximum spacing of 45" between cords.

PART 3: EXECUTION

Frames of blinds and shades shall be installed in required location, set accurately with respect to adjacent building elements, level and square. Anchors shall be as recommended by manufacturer and shall be securely anchored. Width of units shall be verified with Architect. Motorized shading devices shall be installed by manufacturer or manufacturers authorized installer using approved licensed electrician or contractors electrician. An electrical permit shall be issued by the governing body for this work. Materials shall be protected against physical damage, stain, or other injury which might be cause for rejection, until the project is accepted by the Owner.

END OF SECTION

\

SECTION 123216: PLASTIC LAMINATE FACED CABINETWORK

PART 1: GENERAL

1-01: Reference to Other Documents: Drawings and general provisions of the Contract, including General and Supplementary General Conditions, Additional Amended & Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1-02: Work Included: This section includes labor, materials, equipment and related services necessary to furnish and install manufactured base and wall cabinetwork with countertop and backsplash as shown on the drawings and specified herein.

1-03: Substitutions: For purposes of establishing type and quality of materials required for work included in this section, the products of the following manufacturers are listed as approved for use on this project:

1) TMI Systems Design Corp., Dickinson ND.
2) LSI Corporation, Minneapolis, MN
3) Stevens Cabinet Co., Teutopolis IL

Other manufactures shall be pre-approved by Owner and Architect and approval acknowledged by addenda during the bidding period.

1-04: Shop Drawings: Submit 6 copies of shop drawings of cabinetwork to show location, arrangement, dimensions, materials, construction, hardware, finishes, laboratory fixtures and other pertinent information. No items shall be delivered to site until these drawings have been approved. The General Contractor is responsible for coordinating field dimensions.

1-05: Delivery and Storage: No items shall be delivered to the building until temperature and humidity conditions are approximately those which will exist when the building is in use by the Owner. The General Contractor shall designate a place for storage upon delivery until installation is complete. Protect items from physical damage or stain.

1-06: Related work specified in other areas:

Rubber Base	see Section 096500
Plumbing Fixtures	see Division 22
Electrical Devices	see Division 26

1-07: Warranty: All materials and workmanship covered by this section will carry a 5-year warranty from date of acceptance by Architect and Owner.

PART 2: PRODUCTS

2-01: General

a) The Casework Subcontractor shall furnish and install all cutouts, fillers, scribes, finished ends, finished backs and tops as required for a complete finished product.
b) Finished rubber base shall be furnished and installed by the General Contractor.
c) MCP II or Thermofused Melamine will NOT be permitted on door and drawer fronts or other exposed faces.
d) All door and drawers shall have a full 3mm PVC edge. (T-mold is not acceptable).
e) All countertops shall be Solid Surface counters and backsplashes as shown on the drawings equal to Corian solid surface ¾" thick. Colors to be selected from manufacturers standard colors.

\

f) All cabinet components shall be 3/4" thick BEFORE lamination, unless otherwise listed on drawings or specified herein.
g) All base and wall cabinets over 36" wide shall have a full height vertical divider.
h) Interiors shall be selected from manufacturer's full range. PVC Color shall be selected from standards.
i) All sink base bottoms and sides shall be laminated with CL-20 cabinet liner.
j) For bidding purposes provide locks on 50% of cabinets.
k) All shelves shall be banded on front edge with 3mm PVC edging.

2-02: Definitions

a) Unit Body Open Interiors - any storage unit surface without solid door or drawer fronts and units with glass sliding or glass frame doors.
b) Unit Body Closed Interiors - any storage unit surface behind solid door or drawer fronts.
c) Unit Body Exposed Side - any storage unit exterior side surface that is visible.
d) Concealed Surfaces - any surface not normally visible after installation.

2-03: Core Materials

a) Particleboard - minimum density 45 lb. western particleboard of fir or pine meeting or exceeding ANSI A208 1-1979, 1-M-3 requirements. Thickness used shall be 1/4", 1/2", 3/4" and 1".
b) Hardboard - prefinished hardboard in 1/4" thickness meeting or exceeding commercial standards CS-251.
c) Plywood - 9 ply veneer core hardwood.

2-04: Decorative Laminates

a) GP50 - high pressure (0.050), NEMA Test LD-3-1985.
b) GP38 - high pressure (0.038), NEMA Test LD-3-1985.
c) GP28 - high pressure (0.028), NEMA Test LD-3-1985; laminate shall be counter balanced.
d) PF42 - high pressure (0.042), NEMA Test LD-3-1985.
e) CL20 - high pressure (0.020, NEMA Test LD-3-1985; cabinet liner shall be counter balanced.
f) Melamine Laminate - NEMA Test LD-3-1985; laminate shall be counter balanced.
g) BK20 - high pressure (0.020); laminate shall be counter balanced.
h) Colors:
    1) Colors for countertop grades GP50, GP38, PF42 and PF30 shall be selected from Wilsonart's standards, 5 colors maximum per project.
    2) Colors for cabinet surfaces grade GP28 shall be selected from Wilsonart's standards, 1 color per unit face and 5 colors maximum per project.

2-05: Plastic Edging: 3mm PVC - hot melt glue applied.

2-06: Metal Parts: Countertop support brackets, legs and miscellaneous metal parts shall be furniture steel, welded, degreased, cleaned, treated and powder painted. Color to be selected from standards, 1 color per project.

2-07: Cabinet Hardware

a) Pulls - shall be 96mm surface mounted die-cast zinc alloy, powder coated epoxy finish. One color to be selected from standards. Pulls shall be accurately positioned and mechanically fastened from the inside face of door or drawer. Pulls to be compatible with requirements of Americans with Disabilities Act.

b) Hinges - shall be 5-knuckle 2-3/4" overlay type, hospital tip, 0.095" thick steel. Hinges shall have 8 minimum edge and leaf fastenings. Doors 48" and over in height shall have 3 hinges per door. Magnetic door catches are required with this hinge and shall have minimum 10 lb. pull, attached with screws and slotted for adjustment.

c) Extension Drawer Slides:

\

1) Bottom mount - shall be Blum No. BS 230E with epoxy finish. Slides shall have 100 lb. load rating at full extension, with built-in positive stop both directions. Glides shall have lifetime warranty as offered by manufacturer.

2) Paper storage drawers - shall be Blum No. BS 230E with epoxy finish and lifetime warranty.

3) Knee space drawers - shall be Grant No. 522 with minimum load capacity of 50 lbs. each.

d) Adjustable Shelf Supports

Units shall be capable of supporting 200 lbs., self-locking nylon, to fit 32mm pre-drilled holes in cabinet ends and vertical partitions. Shelf supports shall have 2 pins 5mm in diameter to prevent shelf support from rotating and tipping. Available for 3/4" or 1" thick shelves.

e) Locks:

1) Doors and Drawers - locks shall be National Lock #M4-7054C, removable core, disc tumbler, cam style lock with strike. Each lock shall be furnished with 2 keys, all locks to be keyed alike per classroom. Each classroom shall be keyed separately.

2) Sliding Doors, 3/4" - locks shall be disc type plunger lock, sliding door type with strike. Locks for sliding glass door shall be ratchet type sliding showcase lock.

3) Chain Bolts - units shall be 3" long, with 18" pull and an angle strike to secure inactive door on cabinets over 72" in height. Elbow catches shall be used on inactive doors up and including 72" in height.

f) Sliding Door Track

Wood and glass sliding doors shall be mounted in anodized aluminum double channel.

g) Coat Rods

Units shall be 1-1/4" o.d., 14-gauge chrome-plated steel.

h) Mirrors

Units shall be 1/4" thick polished mirror plate.

i) Undercounter shelf supports:

Welded steel countertop support frames shall be provided at all knee spaces as indicated on drawings. Frames to be fabricated from minimum 1 1/4" square steel tube frame with flange for attachment to wall with 1/2" expansion anchors 12" O.C. Frames to be factory finished, color to be selected from manufacturer' s standards.

2-08: Fabrication

a) General

Fabricate laminate clad casework to dimensions, profiles and details shown on drawings.

b) Joinery

Tops and bottoms shall be joined to ends using 6 dowels min. at each joint for 24" deep cabinets and 4 dowels min. at each joint for 12" deep cabinets. All dowels shall be industrial grade hardwood laterally fluted with chamfered ends and minimum diameters of 10mm. Internal components such as fixed horizontals, rails and verticals shall be doweled in place. Dowels shall be securely glued and cabinets clamped under pressure during assembly to assure secure joints and cabinet squareness.

c) Unit Door and Drawer Fronts

Units shall be 3/4" thick particleboard laminated with GP28 on exposed surface and CL20 on interior surface. Edges shall be finished with 3mm PVC. Double doors shall be used on all cabinets in excess of 24" in width.

d) Unit body Open Interiors

Exposed cabinet shall be 3/4" thick particleboard laminated with GP28 on exterior and balanced with CL20. Unexposed cabinet sides shall be laminated both sides with melamine. All cabinet sides shall be front edge banded with 3mm PVC with color matching door and drawer fronts. All base units except sink bases to be furnished with full sub-top of 3/4" thick particleboard laminated with both sides with melamine and front-edged with 1mm PVC to match door and drawer front edge color. All sub-tops shall be full depth. Bottom of base and wardrobe units shall be 3/4" thick particleboard laminated both sides CL20 and front edged with 1mm PVC. Fixed intermediates shall be 3/4" thick particleboard laminated both sides with melamine and front edged with 1mm PVC; an intermediate shall be provided on all units over 36" wide. Standard unit back shall be 1/2" thick prefinished particleboard, color to match interior. Exposed back on fixed or movable cabinet to be 3/4" thick particleboard laminated with CL20 on interior and GP28 on exterior. Adjustable shelves shall be 3/4"

particleboard up to 30" wide and 1" thick over 30" wide, laminated both sides with melamine and front edged with 3mm PVC to match shelf color.

e) Unit Body Closed Interiors

Requirements listed above (Item d.) shall be included herein with the following exception:

1) Sink cabinet bottoms shall be laminated both sides with CL20.

f) Wall Unit Bottoms

Requirements listed above (Item d.) shall be included herein.

g) Drawers

Sides, back and sub-front shall be particleboard, 1/2" thick, laminated with melamine. the back and sub-front shall be doweled and glued into sides. Top edge is banded with 3mm PVC edging. Bottom shall be 1/2" thick prefinished particleboard screwed directly to bottom edge of drawer box. Paper storage drawers shall be 3/4" particleboard laminated both sides with melamine and constructed with retaining hood at rear of each drawer.

h) Continuous or Unit Tops

All cabinets over 42" and up to 72" in height shall be supplied where shown with a finished 1" continuous top laminated with GP28 and balanced with CL20.

8) Bases

All base and tall units shall have an integral base. Rubber base shall be furnished and installed by General Contractor around all edges exposed to view. Separate plywood base is acceptable.

PART 3: EXECUTION

3-01: General: Cabinet Installer must examine surfaces and areas to receive casework and report to General Contractor and Architect of unsatisfactory conditions. Do not proceed with work unit defective conditions have been corrected; installing products shall be understood by all parties of the acceptance and responsibility by the Installer of conditions being acceptable.

3-02: Cabinets shall be set accurately in place, level, plumb in proper relation to adjacent construction. Connecting and attaching devices, closures, and trim members shall be supplied and installed as required. Moving parts shall be adjusted to operate freely. Debris shall be removed from site as it accumulates. Exterior and interior surfaces shall be cleaned and left from stain, dust, or foreign materials of any kind. Cabinets shall be protected from damage or stain until accepted by the Owner.

3-03: Cleaning and Protection: Repair or remove and replace defective work as directed upon completion of installation. Clean plastic surfaces, repair minor damage as directed by plastic laminate manufacturer; replace other damaged parts or units. Advise contractor of procedures and precautions for protection of casework and tops from damage by other trades until acceptance of work by Owner.

END OF SECTION

DIVISION 21

FIRE PROTECTION

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 211313 – Wet-Pipe Sprinkler Systems.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Sleeves.
3. Escutcheons.
4. Grout.
5. Fire-suppression equipment and piping demolition.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Escutcheons.

B. Welding certificates.

C. Contractor’s Shop Drawings including Calculations and product data. Provide a minimum of six hard copies, or submitted electronically in PDF format.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products referred to but not listed to the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.5 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with screw or spring clips.
l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

        1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PAINTING

A. Paint all piping, hangers, rods, and supports exposed to view or to the outdoor elements. Prepare pipe with appropriate cleaner. All rust, loose scale, oil, grease, and dirt shall be removed by use of approved solvents, wire brushing, grinding or sanding. Piping and supports must be clean and dry prior to painting.

B. One coat: Sherman Williams S-W DTW Acrylic Primer Finish, B66W1. Two Coats Sherman Williams S-W DTM Acrylic Coating, B66 Series. Color to be red where exposed in mechanical or electrical rooms, match surrounding wall and ceiling finish where exposed to finish spaces.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION 210500

SECTION 211313 – WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinklers.
4. Alarm devices.
5. Pressure gages.

B. Related Sections:

1. Section 210500 Common Work Results for Fire Suppression.

1.3 DEFINITIONS

A. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13, edition 2013 for obtaining approval from authorities having jurisdiction.

B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

C. National Fire Protection Association, NFPA 13 edition 2013 shall apply to this project.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Design complete sprinkler system and obtain approval from authorities having jurisdiction.

B. Water Supply Test Requirements:

1. Obtain, or perform, current water flow test – conducted within the last 12 months. The contractor shall provide complete working drawings and hydraulic calculations on that water flow and pressure data. Strictly follow City of Raleigh Fire Marshal guidelines for flow tests and sprinkler drawing submittal.

2. A safety factor to account for fluctuations in the water supply shall be included in the contractor's design calculations. This safety factor shall be based on an available water supply of 10 PSI less static pressure, 10 PSI less than residual pressure, land 10-percent less residual water flow than measured.

C. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:

1. Include losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications: As follows per NFPA 13-2013:
    a. Building shell space: Light Hazard. In general, space sprinklers should be no more than 12-ft x 12-ft.
    b. Electrical Equipment Rooms: Ordinary Hazard, Group 2.
    c. Mechanical Equipment Rooms: Ordinary Hazard, Group 2.
    d. Storage Rooms: Ordinary Hazard, Group 2 and Rack Storage
    e. Corridors and Lobbies: Light Hazard.
    f. Minimum Density for Automatic-Sprinkler Piping Design: Per NFPA 13-2013.
3. Maximum Protection Area per Sprinkler: As shown on drawings and per NFPA 13-2013.

D. Components and Installation: Capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Pipe and fitting materials and methods of joining for sprinkler piping.
2. Pipe hangers and supports.
3. Valves, including specialty valves, accessories, and devices.
4. Alarm devices. Include electrical data.
5. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction. Include hydraulic calculations.

C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

D. Maintenance Data: For each sprinkler specialty to include in maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.

B. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Level 3 certified technician. Base calculations on results of fire-hydrant flow test.

C. Professional Engineer (or NICET Level 3 Technician) Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of fire-suppression piping that are similar to those indicated for this Project in material, design, and extent.

D. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

E. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.

F. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

H. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Specialty Valves and Devices:

a. Badger Fire Protection, Inc.
b. Central Sprinkler Corp.
c. Firematic Sprinkler Devices, Inc.
d. Globe Fire Sprinkler Corp.
e. Grinnell Corp.
f. Reliable Automatic Sprinkler Co., Inc.
g. Tyco

h. Viking Corp.

2. Water-Flow Indicators and Supervisory Switches:

   a. Gamewell Co.
   b. Grinnell Corp.
   c. Pittway Corp.; System Sensor Div.
   d. Potter Electric Signal Co.
   e. Reliable Automatic Sprinkler Co., Inc.
   f. Viking Corp.
   g. Watts Industries, Inc.; Water Products Div.

3. Sprinkler, Drain and Alarm Test Fittings:

   a. Fire-End and Croker Corp.
   b. Grinnell Corp.
   c. Victaulic Co. of America.

4. Sprinkler, Branch-Line Test Fittings:

   a. Elkhart Brass Mfg. Co., Inc.
   b. Fire-End and Croker Corp.
   c. Smith Industries, Inc.; Potter-Roemer Div.

5. Sprinkler, Inspector's Test Fittings:

   a. Fire-End and Croker Corp.
   b. G/J Innovations, Inc.
   c. Triple R Specialty of Ajax, Inc.

6. Sprinklers:

   a. Globe Fire Sprinkler Corp.
   b. Grinnell Corp.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire Protection Products
   e. Viking Corp.

7. Indicator Valves:

   a. Central Sprink, Inc.
   b. Grinnell Corp.
   c. McWane, Inc.; Kennedy Valve Div.
   d. Milwaukee Valve Co., Inc.
   e. Nibco, Inc.
   f. Victaulic Co. of America.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPES

A. Ductile-Iron Pipe: AWWA C151, push-on-joint type; with cement-mortar lining and seal coat according to AWWA C104. Include rubber gasket according to AWWA C111.

B. Standard-Weight Steel Pipe: ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 6 and smaller, and Schedule 30 in NPS 8 and larger.

C. Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 (DN125) and smaller and NFPA 13 specified wall thickness in NPS 6 to NPS 10.

D. All black steel piping shall be listed as sprinkler pipe and include FM approved MIC inhibiting coating.

E. Flexible sprinkler fittings (connectors, braded hose) that replace threaded hard pipe drops and arm-overs are not allowed, regardless of their listing.

2.4 PIPE FITTINGS

A. Ductile-Iron Fittings: AWWA C110, ductile-iron or cast-iron push-on-joint type; or AWWA C153, ductile-iron, compact push-on-joint type. Include cement-mortar lining and seal coat according to AWWA C104 and rubber gaskets according to AWWA C111.

B. Cast-Iron Threaded Flanges: ASME B16.1.

C. Cast-Iron Threaded Fittings: ASME B16.4.

D. Malleable-Iron Threaded Fittings: ASME B16.3.

E. Steel, Threaded Couplings: ASTM A 865.

F. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.

G. Steel Flanges and Flanged Fittings: ASME B16.5.

H. Steel, Grooved-End Fittings: UL-listed and FM-approved, ASTM A 47 (ASTM A 47M), malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.5 JOINING MATERIALS

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for pipe-flange gasket materials and welding filler metals.

2.6 GENERAL-DUTY VALVES

A. Refer to Division 22 Section "Valves" for gate, ball, butterfly, globe, and check valves not required to be UL listed and FM approved.

2.7 FIRE-PROTECTION-SERVICE VALVES

A. General: UL listed and FM approved, with minimum 175-psig nonshock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.

B. Gate Valves, NPS 2 and Smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.

C. Indicating Valves, NPS 2-1/2 and Smaller: UL 1091; butterfly or ball-type, bronze body with threaded ends; and integral indicating device.
   1. Indicator: Electrical 115-V ac, prewired supervisory switch.

D. Gate Valves, NPS 2-1/2 and Larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.

E. Indicator-Post, Gate Valves: UL 262, iron body, bronze mounted, solid-wedge disc, and nonrising stem with operating nut and flanged ends.

F. Swing Check Valves, NPS 2 and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.

G. Swing Check Valves, NPS 2-1/2 and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.

H. Split-Clapper Check Valves, NPS 4 and Larger: UL 312, cast-iron body with rubber seal, bronze-alloy discs, and stainless-steel spring and hinge pin.

2.8 SPECIALTY VALVES

A. Alarm Check Valves: UL 193, 175-psig working pressure; designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

   1. Option: Grooved-end connections for use with keyed couplings.
   2. Drip Cup Assembly: Pipe drain without valves, and separate from main drain piping.

B. Ball Drip Valves: UL 1726, automatic drain valve, NPS 3/4 , ball check device with threaded ends.

2.9 SPRINKLERS

A. Automatic Sprinklers: With heat-responsive element complying with the following:

   1. UL 199, for applications except for ESFR.

2. UL 1767, for early suppression, fast-response applications.

B. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

a. Orifice: 1/2 inch (12.7 mm), with discharge coefficient K between 5.3 and 5.8.
b. Orifice: 17/32 inch (13.5 mm), with discharge coefficient K between 7.4 and 8.2.

C. Sprinkler types, features, and options include the following:
1. Pendent, dry-type sprinklers.
2. Concealed sprinklers.
3. Sidewall sprinklers.
4. Sidewall, dry-type sprinklers.
5. Upright sprinklers.

D. Sprinkler Finishes: Chrome-plated, bronze, and painted.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Concealed Style, Standard white finish.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

F. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.10 SPECIALTY SPRINKLER FITTINGS

A. Specialty Fittings: UL listed and FM approved; made of steel, ductile iron, or other materials compatible with piping.

B. Locking-Lug Fittings: UL 213, ductile-iron body with locking-lug ends.

C. Mechanical-T Fittings: UL 213, ductile-iron housing with pressure-responsive gasket, bolts, and threaded or locking-lug outlet.

D. Mechanical-Cross Fittings: UL 213, ductile-iron housing with pressure-responsive gaskets, bolts, and threaded or locking-lug outlets.

E. Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.

F. Sprinkler, Drain and Alarm Test Fittings: UL-listed, cast- or ductile-iron body; with threaded inlet and outlet, test valve, and orifice and sight glass.

G. Sprinkler, Branch-Line Test Fittings: UL-listed, brass body; with threaded inlet and capped drain outlet and threaded outlet for sprinkler.

H. Sprinkler, Inspector's Test Fittings: UL-listed, cast- or ductile-iron housing; with threaded inlet and drain outlet and sight glass.

2.11 FIRE DEPARTMENT CONNECTIONS

A. Wall, Fire Department Connections: UL 405; cast-brass body with brass, wall, escutcheon plate; brass, lugged caps with gaskets and brass chains; and brass, lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking "AUTOMATIC SPRINKLER."

1. Type: Flush mounting.
2. Escutcheon Plate: Rectangular.
3. Finish: Polished chrome-plated.

B. Exposed, Freestanding, Fire Department Connections: UL 405, cast-brass body, inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, and bottom outlet with pipe threads. Include brass, lugged caps, gaskets, and brass chains; brass, lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high brass sleeve; and round, floor, brass, escutcheon plate with marking "AUTOMATIC SPRINKLER."

1. Finish Including Sleeve: Polished chrome-plated.

2.12 ALARM DEVICES

A. General: Types matching piping and equipment connections.

B. Water-Motor-Operated Alarms: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 inlet and NPS 1 drain connections.

C. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

D. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

E. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

F. Indicator-Post Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

2.13 PRESSURE GAGES

A. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch- diameter dial with dial range of 0 to 250 psig.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article in Part 1 of this Section.

B. Report test results promptly and in writing.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

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

3.3 PIPING APPLICATIONS

A. Do not use welded joints with galvanized steel pipe.

B. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

C. Piping between Fire Department Connections and Check Valves: Use galvanized, standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

D. Sprinklers: Use the following:

E. Wet-Pipe Sprinklers: Use the following:
   1. NPS 1-1/2: and Smaller: Standard-weight steel pipe with threaded ends, cast- or malleable-iron threaded fittings, and threaded joints.
   2. NPS 2: Standard-weight steel pipe with threaded ends, cast- or malleable-iron threaded fittings, and threaded joints.
   3. NPS 2-1/2 to NPS 3-1/2: Schedule 10 steel pipe with roll-grooved ends; steel, grooved-end fittings; and grooved joints.
   4. NPS 4: Schedule 10 steel pipe with roll-grooved ends; steel, grooved-end fittings; and grooved joints.
   5. NPS 5 and NPS 6: Schedule 10 steel pipe with roll-grooved ends; steel, grooved-end fittings; and grooved joints.

3.4 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 13 and NFPA 14.

a. Shutoff Duty: Use gate valves.

2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13 and NFPA 14.

a. Shutoff Duty: Use gate, ball, or butterfly valves.
b. Throttling Duty: Use globe, ball, or butterfly valves.

3.5 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Ductile-Iron-Piping, Grooved Joints: Use ductile-iron pipe with radius-cut-grooved ends; ductile-iron, grooved-end fittings; and ductile-iron, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.

C. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 10 steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

3.6 PIPING INSTALLATION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Install underground service-entrance piping according to NFPA 24 and with restrained joints.

D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

G. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install drain valves on standpipes.

K. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

L. Install alarm devices in piping systems.

M. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.

N. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.

O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

3.7 VALVE INSTALLATION

A. Refer to Division 22 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13, manufacturer's written instructions, and authorities having jurisdiction.

B. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.

C. Install Reduced-Pressure Zone Detector type check valve in each water-supply connection.

D. Alarm Check Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain-line connection.

3.8 SPRINKLER APPLICATIONS

A. General: Use sprinklers according to the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Recessed sprinklers.

a. Upright, Pendent, ESFR, and Sidewall Sprinklers: Chrome-plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
b. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

3.9 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical panels and tiles.

B. Install recessed style sprinklers in the mid-range of available adjustment. All installed recessed sprinklers shall have equal recess – tolerance of plus or minus 1/8” inch.

C. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.10 CONNECTIONS

A. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

B. Connect piping to specialty valves, specialties, fire department connections, and accessories.

C. Electrical Connections: Power wiring is specified in Division 26.

D. Connect alarm devices to fire alarm.

3.11 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
5. Bare Piping in Equipment Rooms: One piece, cast brass with polished chrome-plated finish.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.12 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 22 Section "Mechanical Identification."

3.13 FIELD QUALITY CONTROL

A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.

B. Flush, test, and inspect underground piping according to NFPA 24.

C. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

D. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.14 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers having paint other than factory finish.

3.15 PROTECTION

A. Protect sprinklers from damage until Substantial Completion.

3.16 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete.

C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

E. Verify that potable-water supplies have correct types of backflow preventers.

F. Drain dry-pipe sprinkler piping.

G. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.

H. Fill wet-pipe sprinkler piping with water.

I. Verify that hose connections are correct type and size.

J. Energize circuits to electrical equipment and devices.

K. Coordinate with fire alarm tests. Operate as required.

3.17 DEMONSTRATION

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

3.20 PAINTING

A. Paint all exposed sprinkler piping bright red, one coat of primer, two coats of enamel.

3.18 CLOSEOUT

A. The fire protection contractor shall have for review all pertinent NFPA paperwork properly completed on NFPA forms as applicable (NFPA 13, 14, 20, 24). A set of as-built fire sprinkler shop drawings and hydraulic calculations shall be placed in a white PVC tube marked “FIRE SPRINKLER SHOP DRAWINGS” and securely fixed in the fire sprinkler riser room. A second set of “as-built” shop drawings shall be provided to the owner. A copy of the shop drawings and calculations shall be provided in PDF format on CD.

END OF SECTION 211313

DIVISION 22

PLUMBING

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Plumbing demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 QUALITY ASSURANCE

A. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.4 COORDINATION OF TRADES

A. Check, verify and coordinate work with other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with the building structure or other trades.

B. Drawings and specifications are necessarily schematic in nature and cannot describe completely all situations that might be encountered in the field. It is the responsibility of the contractor to familiarize himself with the scope of work required and include all work indicated or reasonably implied by the contract documents.

C. Layout the work to prevent conflict with, and to co-ordinate with work of other trades. Systems shall generally be run in a rectilinear fashion.

D. Each trade is responsible for the coordination of their work with all other work at the site prior to beginning in each area.

E. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

F. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

G. Coordinating space requirements, supports, 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; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

H. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.6 DIVISION OF WORK (Division 22/26)

A. This section delineates the division of work between Division 22 and Division 26.

B. Specific work to be done under Division 26 is hereinafter listed or described. All other work necessary for the operation of Division 22 equipment shall be performed under Division 22.

C. All individual motor starters for mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Division 22 unless indicated as a part of a motor control center. Motor starters for mechanical equipment provided in motor control centers shall be furnished under Division 26.

D. Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter or disconnect switch. Under Division 26 line side terminations shall be provided. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Division 22.

E. All relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote pushbutton stations, emergency break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 22 shall be furnished, installed and wired under Division 22.

F. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 22.

G. Where electrical wiring is required by trades other than covered by Division 26, specifications for that section shall refer to same wiring materials and methods as specified under Division 26. No Exceptions.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

2.5 SLEEVES

A. Steel Pipe for pipe penetrations: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

D. Sleeves shall be installed for all pipe penetrations of floor slabs above grade. Tops of sleeves shall extend 2” above the floor.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install escutcheons for penetrations of walls, ceilings, and floors.

I. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

J. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

K. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to Division 22 Sections specifying piping systems.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Attach to substrates as required to support applied loads.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

3.9 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces. Execute cutting and patching including excavation and fill to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.

C. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

F. Restore work with new Products in accordance with requirements of Contract Documents.

G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material, to full thickness of the penetrated element.

I. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

END OF SECTION 220500

SECTION 220505 EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Excavating and backfilling trenches within building lines.
   2. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:
   1. Division 23 and 26 Sections for excavating and backfilling buried mechanical and electrical utilities and buried utility structures.

1.3 SUBMITTALS

A. Product Data: For the following:

   1. Each type of plastic warning tape.

1.4 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

3.2 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches on each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.3 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

C. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.4 COMPACTION OF BACKFILLS

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

3.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 220505

SECTION 220510 – PIPE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Pressure testing of piping systems.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PIPE TESTING

A. Test all piping as specified herein. Test results shall demonstrate no leaks or appreciable loss of pressure. Repair or replace defective piping until tests are accomplished successfully.

B. All nitrogen used for testing shall be oil-free dry nitrogen.

C. All air used for testing shall be clean, dry, and oil-free.

D. All piping systems shall be cleaned after testing

E. Gas piping system shall be tested with air or nitrogen at 1 1/2" times proposed maximum working pressure but not less than 50 psig. Test duration will be 4 hour minimum. The system will withstand the test pressure with no evidence of leakage. Any reduction of test pressure as indicated by pressure gauge shall be deemed to indicate the presence of a leak. The leakage shall be located by means of soap and water, or an approved equivalent nonflammable solution as applicable. Reference NFPA 54 for further details on gas pipe testing.

F.

System	Pressure	Medium	Duration
Hot & Cold water (domestic)	150 psig	water	4 hours
Natural gas	50 psig	air	8 hours
Waste & vent	10 feet	water	4 hours

END OF SECTION 220510

SECTION 220513 - COMMON MOTOR AND CONTROLLER REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 SUBMITTALS

A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

B. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:

a. Magnetic controllers.

b. Multispeed controllers.

c. Reduced-voltage controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.

3. Matched to torque and horsepower requirements of the load.

4. Matched to ratings and characteristics of supply circuit and required control sequence.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply to factory-installed and field-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.

2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.2 MOTOR CHARACTERISTICS

A. Motors 1/2 HP and Larger: Three phase.

B. Motors Smaller Than 1/2 HP: Single phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open drip proof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Open drip proof for general use, weatherproof, explosion proof, etc., as required for special duty application.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Efficiency: Motors shall be premium efficiency to comply with Senate bill 668.

C. Stator: Copper windings, unless otherwise indicated.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.

2. Temperature Rise: Matched to rating for Class B insulation.

3. Insulation: Class H.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, sleeve type for other single-phase motors.

2.6 CONTROLLERS AND CONTROLS:

A. Controllers shall conform to adopted standards and recommended practices of the Industrial Control Standards of the National Electrical Manufacturers Association and the standard for Industrial Control Equipment of the Underwriters Laboratories, Inc. Single phase motors shall be provided with integral overload protection.

B. Two (2) speed, three phase motors shall be one winding consequent pole type.

C. Magnetic starters for motors 50 hp and smaller shall be full voltage, across the line type with undervoltage release for manual or automatic operation and shall break all phases on 3 phase starters.

D. Starters for motors 60 hp and above shall be reduced voltage type. Starters shall be provided with start-stop pushbuttons mounted on cover unless controlled by hand-off-automatic device. Hand-off-automatic device shall not be wired to override safety device interlocks on starter mounted on or adjacent to starter except where indicated on plans. If selector is mounted remotely, provide test start pushbutton on starter. All auxiliary contacts required for interlocking purposes shall be furnished and installed with starter. All manual motor starters shall be quick-make, quick-break, toggle action types with one-piece melting alloy type thermal units and pilot light.

E. Starters shall be provided with proper size thermal elements which shall be of one-piece, interchangeable construction. The starter shall not operate with any element removed. All starters installed outdoors shall be provided with ambient temperature compensating motor overload devices. All starter enclosures shall be NEMA 1, indoors and NEMA 3R in exterior areas, unless noted otherwise.

F. All starters and pushbutton stations shall be provided with labels as specified under identification designating service for which starter is used. Plate shall be firmly attached to starter or wall mounted adjacent to starter.

G. Provide thermal element selection chart on the inside of each starter door.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.

2. Test interlocks and control features for proper operation.

3. Verify that current in each phase is within nameplate rating.

3.2 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.3 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 220513

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product certificates.

C. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Thermometers:

a. Weksler Instruments Operating Unit.
b. Ernst Gage Co.
c. Palmer Instruments, Inc.
d. H. O. Trerice Co.
e. Weiss Instruments, Inc.
f. Ashcroft Commercial Sales Operation.

2. Pressure Gages:
a. Ashcroft Commercial Sales Operation.
b. Weksler Instruments Operating Unit.
c. Ernst Gage Co.
d. Marsh Bellofram.
e. Trerice: H. O. Trerice Co.
f. Weiss Instruments, Inc.

2.2 THERMOMETERS, GENERAL

A. Scale Range: Temperature ranges for services listed are as follows:

1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
3. Hot Water: 30 to 240 deg F, with 2-degree scale divisions.

B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

C. Use digital type thermometers.

2.3 DIGITAL THERMOMETERS

A. Description: Variable angle, light powered, digital thermometer.

B. Case: High impact ABS.

C. Display: 3/8" LCD digits, wide ambient formula.

D. Lux rating: 10 lux (1 foot candle)

E. Update: 10 seconds

F. Ambient operating temperature: -30°F to 140°F

G. Sensor: Glass passivated thermistor

H. Stem assembly: Industrial glass type

I. Fahrenheit to Celsius switchable

J. Weiss Vari-angle Digital thermometer or equal

2.4 SEPARABLE SOCKETS

A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.

1. Material: Brass, for use in copper piping.
2. Material: Stainless steel, for use in steel piping.
3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
4. Insertion Length: To extend to one-third of diameter of pipe.
5. Cap: Threaded, with chain permanently fastened to socket.
6. Heat-Transfer Fluid: Oil or graphite.

2.5 THERMOMETER WELLS

A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.

1. Material: Brass, for use in copper piping.

2. Material: Stainless steel, for use in steel piping.
3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
4. Insertion Length: To extend to one-third of diameter of pipe.
5. Cap: Threaded, with chain permanently fastened to socket.
6. Heat-Transfer Fluid: Oil or graphite.

2.6 PRESSURE GAGES

A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.

B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch- diameter, glass lens.

C. Connector: Brass, NPS 1/4.

D. Scale: White-coated aluminum with permanently etched markings.

E. Accuracy: Grade A, plus or minus 1 percent of middle 50 percent of scale.

F. Range: Comply with the following:

1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure.
2. Fluids under Pressure: Two times the operating pressure.

2.7 PRESSURE-GAGE FITTINGS

A. Valves: NPS 1/4 copper or bronze ball valve.

B. Syphons: NPS 1/4 coil of brass tubing with threaded ends.

C. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 METER AND GAGE INSTALLATION, GENERAL

A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

3.2 THERMOMETER INSTALLATION

A. Install digital thermometers and adjust vertical and tilted positions.

B. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.

1. Install with socket extending a minimum of 2 inches into fluid.
2. Install with socket extending to one-third of diameter of pipe.
3. Install with socket extending to center of pipe.
4. Fill sockets with oil or graphite and secure caps.

C. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.

1. Install with stem extending a minimum of 2 inches into fluid.
2. Install with stem extending to one-third of diameter of pipe.
3. Install with stem extending to center of pipe.
4. Fill wells with oil or graphite and secure caps.

3.3 PRESSURE-GAGE INSTALLATION

A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.

B. Install liquid-filled-type pressure gages at suction and discharge of each pump.

C. Install pressure-gage needle valve and snubber in piping to pressure gages.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:

1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.
2. Connect flow-measuring-system elements to meters.
3. Connect flowmeter transmitters to meters.
4. Connect thermal-energy-flowmeter transmitters to meters.

B. Make electrical connections to power supply and electrically operated meters and devices.

C. Ground electrically operated meters.

3.5 ADJUSTING AND CLEANING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Bronze gate valves.
7. Iron gate valves.
8. Bronze globe valves.
9. Iron globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.2 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures, 200 psi CWP minimum.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
4. Wrench: For plug valves with square heads.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.
4. Bronze Valves: NPS 2 and smaller with threaded or solder ends, unless otherwise indicated.
5. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.
g. Conbraco Industries, Inc.; Apollo Valves.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2.3 BALL VALVES

A. MSS SP-110, Class 150 Ball Valves, 1/2-Inch to 4-Inch: Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 2-piece construction; with bronze body conforming to ASTM B 62, standard or conventional port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, extended stem for insulated systems, and vinyl-covered steel handle.

2.4 BUTTERFLY VALVES

A. MSS SP-67, Type I, rated bubble tight at 200 psi for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated. Butterfly valves shall have ductile or cast iron body, bronze floating type disc, EPT seat, 416 stainless steel dry journal type stems, bronze bearings. Bodies shall be full lug type with extended necks adequate for the appropriate insulation thickness. Operators shall be 10 position positive lock lever type in sizes 4" to 6", and worm gear operators for 8" and above

2.5 GATE VALVES

A. Gate Valves, 2-Inch and Smaller: MSS SP-80; Class 150, body and union bonnet of ASTM B 62 cast bronze; with threaded ends or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel.

B. Gate Valves, 2-1/2-Inch and Larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; outside screw and yoke, with flanged ends, "Teflon" impregnated packing, and two-piece backing gland assembly.

2.6 GLOBE VALVES

A. Globe Valves, 2-inch and Smaller - MSS SP-80; Class 125; body and screwed bonnet of ASTM B62 cast bronze; with threaded or solder ends, brass of replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.

B. Globe Valves 2-1/2 inch and Larger MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing, and two-piece packing gland assembly.

2.7 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 is not available.

B. Swing Check Valves, 2-1/2 Inch and Larger MSS SP-71; Class 125, cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends.

C. Wafer Check Valves Class 125, 200 psi WOG, cast-iron body with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.

2.8 BALANCING VALVES (CIRCUIT SETTER)

A. Calibrated Balancing Valves, NPS 2 and Smaller: Bronze body, brass ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded or soldered ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position. Valve shall be rated for shutoff service.

B. Calibrated Balancing Valves, NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi; connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position. Valve shall be rated for shutoff service.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Throttling Service: Globe or ball valves.
3. Balancing Service: Circuit setter.
4. Pump Discharge: Spring-loaded, lift-disc or wafer check valves.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: Two piece, regular port, brass or bronze with bronze trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, RS.
6. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: flanged ends
2. Iron Swing Check Valves: Class 125, metal seats.
3. Iron Gate Valves: Class 125, OS&Y.
4. Iron Globe Valves: Class 125.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Equipment supports.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Powder-actuated fastener systems.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

1.6 FINISHES

A. All hangers, supports, fasteners, etc. for outdoor installation shall be hot dip galvanized, indoor hangers shall be painted or galvanized. All hanger rod shall be hot dip galvanized or cadmium plated.

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Design Mix: 5000-psi, 28-day compressive strength.

2.7 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

B. All bracket, clamp and rod sizes indicated are minimum sizes only. The installing trade shall be responsible for structural integrity of all supports. All structural hanging materials shall have a safety factor of 5 built in and shall comply with MSS Standard SP-69.

C. All hangers, supports, fasteners, etc. for outdoor installation shall be hot dip galvanized, indoor hangers shall be painted or galvanized. All hanger rod shall be hot dip galvanized or cadmium plated.

D. Supports for uncovered copper tubing shall be especially designed for copper tubing, shall be of exact outside diameter of tubing and shall be copper plated.

E. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

   1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

   2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.8 MISCELLANEOUS MATERIALS

A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.

   1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   2. Properties: Nonstaining, noncorrosive, and nongaseous.
   3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections. Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

Description	Type
Insulation Protection Shield	40
Pipe saddle	39
Clevis hanger	1
Roller hanger	43
Clevis	14
Eye Nut	17
Eye Socket	16
U-bolt	24
Copper Tubing Hanger	10
Beam Clamp	23
Pipe Roller Stand	44 and 46
Pipe Clamp	4 and 3
Riser Clamp	8
Center Load Beam Clamp	21
Wall Bracket	32 and 33
Welded Beam Attachment	22
Concrete Insert	18
Turnbuckle	13

C. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Supports, anchors, hangers and guides per MSS SP-69 shall be provided for all horizontal and vertical piping. Hangers shall be so arranged as to prevent excessive deflection and avoid excessive bending stresses.

C. All piping within stud walls shall be supported at minimum top and bottom of each vertical run with minimum split ring hangers mounted to structural steel element. See piping manufacturer instruction guidelines for additional information.

D. Clevis type hangers shall be used for support of "cold" or ambient temperature piping systems, provide galvanized insulation shields with flared ends for insulated piping.

E. Roller type supports shall be used for hot pipes subject to axial movement.

F. Supports shall be braced so that movement occurs in roller rather than support rods. Provide beam clamps, turnbuckles, struts, channels, angle iron, and miscellaneous supports as required for a complete installation.

G. Pipe hangers shall be installed no further than 24" from any change of direction.

H. Contractor shall bear all responsibility for materials and workmanship as described in this section and shall make sure that all hangers and supports are properly and permanently connected to building structure.

I. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 PAINTING

A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

C. All hangers, supports, fasteners, etc. for outdoor installation shall be hot dip galvanized, indoor hangers shall be painted or galvanized. All hanger rod shall be hot dip galvanized or cadmium plated.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 SUBMITTAL

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless-steel rivets or self-tapping screws.

G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

B. Pipe Label Color Schedule:

1. Domestic Water Piping:

    a. Background Color: Green
    b. Letter Color: White

2. Sanitary Waste and Storm Drainage Piping:

    a. Background Color: Green.
    b. Letter Color: White.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Flexible elastomeric.
b. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied fabric-reinforcing mesh.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

1.2 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

    a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
    b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

8. Products: Subject to compliance with requirements, provide one of the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000 Pipe Insulation.
    d. Owens Corning; Fiberglas Pipe Insulation.

B. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; CrimpWrap.
    b. Johns Manville; MicroFlex.
    c. Knauf Insulation; Pipe and Tank Insulation.
    d. Owens Corning; Fiberglas Pipe and Tank Insulation.

C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. **Polyethylene or Polymer insulations are not acceptable.** Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Insulation shall be AP/Armaflex or equal.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

D. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 30 mils thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: Color-code piping jackets based on materials contained within the piping system.

D. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil- thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

E. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

F. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.

2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.3 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..

1. Tape Width: 4 inches.

B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.
4. Brass: 0.010 inch thick.
5. Nickel-Copper Alloy: 0.005 inch thick.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

2.4 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

H. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

I. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

J. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

K. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

L. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

M. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal metal jacket to roof flashing with vapor-retarder mastic.

N. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

O. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

P. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."

Q. Floor Penetrations: Apply insulation continuously through floor assembly.

1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.
4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
6. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated (ON ALL EXPOSED WATER PIPING), directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
4. All exposed piping shall be painted including hangers, hanger rods, and saddles. Color shall be chosen by Architect.

B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.

1. Draw jacket material smooth and tight.
2. Apply lap or joint strips with the same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Apply jackets with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

C. Apply PVC jacket where indicated, with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

D. Apply metal jacket where indicated, with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation exposed to view finished with glass-cloth jacket as specified in Division 9 Section "Painting."

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

C. Color: Color code per ANSI or owners standard color scheme. Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.8 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Drainage piping located in crawl spaces, unless otherwise indicated.
5. Below-grade piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.9 FIELD QUALITY CONTROL

A. Inspection: Inspect fittings and valves randomly selected by Engineer.

B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.10 INSULATION APPLICATION SCHEDULE, GENERAL

A. Materials and thicknesses for systems listed below shall comply with the requirements of the North Carolina State Energy Code and shall be not less than the thicknesses specified below.

3.11 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic hot, and recirculated hot water.

1. Operating Temperature: 100 to 139 deg F.
2. Insulation Material: **Mineral fiber**
3. Insulation Thickness: Apply the following insulation thicknesses:
   All pipe sizes”..... .... 1"
4. Field-Applied Jacket: Painted glass cloth **for exposed areas per section 3.6A, Foil and Paper (ASJ) concealed areas.**
5. Vapor Retarder Required: No

B. Service: Domestic cold water.

1. Operating Temperature: 45 to 80 deg F.
2. Insulation Material: **Mineral fiber**
3. Insulation Thickness:
   Pipe size 1" I.P.S. and below..... 1/2"
   Pipe size 1¼” to 2” ..... 1"
   Pipe size 2 1/2” to 6” ..... 1"
4. Field-Applied Jacket: Painted glass cloth **for exposed areas per section 3.6A, Foil and Paper (ASJ) concealed areas.**
5. Vapor Retarder Required: Yes

C. Service: Horizontal and Vertical Sanitary Waste Piping exposed to outside of the building.

1. Operating Temperature: 32 to 100 deg F.
2. Insulation Material: **Mineral fiber**
3. Insulation Thickness: 1”
4. Field-Applied Jacket: **PVC color coded for exposed areas Foil and Paper (ASJ) concealed areas.**
5. Vapor Retarder Required: **Yes**

D. Service: Horizontal Roof Drain Leaders and Rainwater Conductors up to roof drain body.

1. Operating Temperature: 32 to 100 deg F.
2. Insulation Material: **Mineral fiber**
3. Insulation Thickness: 1”
4. Field-Applied Jacket: **PVC color coded for exposed areas Foil and Paper (ASJ) concealed areas.**
5. Vapor Retarder Required: **Yes**

E. Service: Roof Drain bodies.

1. Operating Temperature: 32 to 100 deg F.
2. Insulation Material: **Mineral fiber**

3. Insulation Thickness: 1”
4. Field-Applied Jacket: **PVC for exposed areas Foil and Paper (ASJ) concealed areas.**
5. Vapor Retarder Required: **Yes**

F. Service: Exposed sanitary drains and domestic water supplies and stops for fixtures for the disabled.

1. Operating Temperature: 35 to 120 deg F.
2. Insulation Material: **Mineral fiber**.
3. Insulation Thickness: 1”
4. Field-Applied Jacket: **PVC P-trap and supply covers.**
5. Vapor Retarder Required: Yes

3.12 EXTERIOR INSULATION APPLICATION SCHEDULE

A. This application schedule is for aboveground insulation outside the building.

1. Piping shall be insulated same as interior piping plus with an aluminum weatherproof jacket.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.

B. Related Sections include the following:

1. Division 22 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
2. Division 22 Section "Plumbing Specialties" for water distribution piping specialties.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

C. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 DUCTILE-IRON PIPING

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint, bell- and plain-spigot end, unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron, standard pattern; or AWWA C153, ductile-iron, compact pattern.

    a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2. Ductile-Iron Piping, Grooved-End Fittings: ASTM A 47, malleable-iron castings or ASTM A 536 ductile-iron castings with dimensions matching pipe.

    a. Ductile-Iron-Piping, Keyed Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint, bell- and plain-spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron, standard pattern; or AWWA C153, ductile-iron, compact pattern.

    a. Gaskets: AWWA C111, rubber.

2. Ductile-Iron, Grooved-End Fittings: ASTM A 47, malleable-iron castings or ASTM A 536 ductile-iron castings with dimensions matching pipe.

    a. Ductile-Iron-Piping, Keyed Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

3. Ductile-Iron, Flexible Expansion Joints: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed, ball-joint sections and one or more gasketed, sleeve section. Assemble components for offset and expansion indicated. Include AWWA C111 ductile-iron glands, rubber gaskets, and steel bolts.

4. Ductile-Iron, Deflection Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111 ductile-iron glands, rubber gaskets, and steel bolts.

2.3 COPPER TUBING

A. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.22, wrought-copper, solder-joint fittings.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.22, wrought- copper, solder-joint fittings.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description:

a. Pressure Rating: 150 psig at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

a. Factory-fabricated, bolted, companion-flange assembly.
b. Pressure Rating: 175 psig minimum.
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.5 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

2.6 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.7 SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install domestic water piping level and plumb.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

G. Install piping adjacent to equipment and specialties to allow service and maintenance.

H. Install piping to permit valve servicing.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.3 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

B. Underground Domestic Water Service Piping: Use the following piping materials for each size range:

1. NPS 2 ½" and Smaller: Soft copper tube, Type K; copper pressure fittings; and soldered joints.
2. NPS 3" to NPS 8": Mechanical- or push-on-joint, ductile-iron pipe; mechanical- or push-on-joint, ductile-iron fittings; and restrained, gasketed joints.

C. Aboveground Domestic Water Piping: Use the following piping materials for each size range:

1. NPS 4" and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

3.4 JOINT CONSTRUCTION

A. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Apply appropriate tape or thread compound to external pipe threads.

B. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated solder shall be 95-5 for pipe sizes 1 ¼"" and smaller. Pipe larger than 1 ¼: shall be brazed.

D. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

E. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 22 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: According to the following:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.

F. Install supports for vertical steel piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures

that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flows.

3.7 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.8 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.9 ESCUTCHEON INSTALLATION

A. Install escutcheons for exposed pipe penetrations of walls, ceilings, and floors.

3.10 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Install sleeves in new partitions, slabs, and walls as they are built.

C. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

D. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using **sleeve seals** specified in this Section.

E. Seal space outside of sleeves in concrete slabs and walls with grout.

F. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

G. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.

    a. Extend sleeves 2 inches above finished floor level.
    b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

3. Sleeves for Piping Passing through Gypsum-Board Partitions:

    a. Steel pipe sleeves for pipes smaller than NPS 6.
    b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
    c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
5. Sleeves for Piping Passing through Exterior Concrete Walls:

    a. Steel pipe sleeves for pipes smaller than NPS 6.
    b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
    c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.11 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
3. Cap and subject piping to static water pressure of 50 psig (125 psig minimum) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3.14 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water hammer arresters.
11. Trap-seal primer valves.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. Watts Industries, Inc.; Water Products Div.
   d. Woodford Manufacturing Company.
   e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Body: Bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cash Acme.
    b. Conbraco Industries, Inc.
    c. Watts Industries, Inc.; Water Products Div.
    d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.
    b. Bell and Gossett
    c. Milwaukee Valve Company.
    d. NIBCO INC.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lawler Manufacturing Company, Inc.
    b. Leonard Valve Company.
    c. Powers; a Watts Industries Co.
    d. Symmons Industries, Inc.

2. Standard: ASSE 1017.

3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
8. Valve Finish: Chrome plated.
9. Piping Finish: Chrome plated.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.033 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
    c. Strainers NPS 5 and Larger: 0.125 inch.

6. Drain: Hose-end drain valve.

2.7 HOSE BIBBS

A. Hose Bibbs:

1. Body Material: Bronze.
2. Seat: Bronze, replaceable.
3. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
4. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
5. Pressure Rating: 125 psig.
6. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
7. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
8. Finish for Finished Rooms: Chrome or nickel plated.
9. Include operating key with each operating-key hose bibb.
10. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

A. Anti Freeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.
c. Woodford Manufacturing Company.
d. Zurn Plumbing Products Group; Light Commercial Operation.
e. Josam.

2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.
6. Operation: Loose key.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4.
9. Outlet: With garden-hose thread complying with ASME B1.20.7.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves Insert drawing designation if any:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER HAMMER ARRESTERS

A. Water Hammer Arresters Insert drawing designation if any:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company.
b. PPP Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. PPP Inc.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install water hammer arresters in water piping according to PDI-WH 201.

E. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

F. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

G. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Intermediate atmospheric-vent backflow preventers.
2. Reduced-pressure-principle backflow preventers.
3. Double-check backflow-prevention assemblies.
4. Water pressure-reducing valves.
5. Primary, thermostatic, water mixing valves.
6. Supply-type, trap-seal primer valves.

H. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.2 FIELD QUALITY CONTROL

A. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT AND ROOF DRAIN LEADER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes soil and waste, sanitary drainage and vent, roof drain leader and rainwater conductor piping inside the building and to locations indicated.

B. Related Sections include the following:
1. Division 22 Section "Plumbing Specialties" for soil, waste, and vent piping systems specialties.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Flexible Transition Couplings for Underground Nonpressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

2.2 SOIL PIPING – WASTE, VENT AND STORM

A. Below Slab Only - Schedule 40 DWV Pipe and Fittings: ASTM D 2665, ASTM D 3311

B. PVC pipe solvent cementing: Joints surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F 656 shall be applied. Solvent cement not of purple color and conforming to ASTM D 2564, CSA B137.3, CSA B181.2 or CSA B181.1 shall be applied to all joint surfaces. Solvent-cement joints shall be permitted below ground. See plans for buried pipe identification.

C. CAST IRON – Above grade Hubless Pipe and Fittings: Hub-and-Spigot Pipe and Fittings: ASTM A 74, Service Weight class, coated for general duty.

1. Gaskets: ASTM C 564, rubber.

D. Hubless Pipe and Fittings: ASTM A 888 or CISPI 301, coated for general duty.

1. Couplings: ASTM C 1540 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.

a. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.

1) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
2) NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Aboveground, Soil, Waste, Vent, and roof drain leader Piping: Use the following piping materials for each size range:
1. Hubless, cast-iron soil piping and one of the following:

a. Couplings: Heavy-duty, stainless steel.

C. Underground, Soil, Waste, Vent, Roof drain leader, and Rainwater Conductor Piping: Use the following piping materials for each size range:
1. Schedule 40 DWV pipe and fittings.

3.2 PIPING INSTALLATION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.

D. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn,

double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

E. Install soil and waste drainage and vent piping at the NCSBC minimum slopes, unless otherwise indicated:

F. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

G. Roof Drain Leader, Waste and Vent piping must be cast iron pipe and fittings.

3.3 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 22 Section "Mechanical Vibration Controls and Seismic Restraints" for seismic-restraint devices.

B. Refer to Division 22 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

C. Install supports according to Division 22 Section "Hangers and Supports."

D. Support vertical piping and tubing at base and at each floor.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
6. NPS 15: 60 inches with 1-inch rod.
7. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install supports for vertical steel piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

3.5 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
c. Tyler Pipe; Wade Div.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Body: Cast iron.
3. Cover: Cast iron with bolted or threaded access check valve.
4. Type Check Valve: Removable, bronze, swing check..

2.2 CLEANOUTS

A. Adjustable Cast-Iron Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Body Material: Cast iron
3. Closure: Gas and watertight ABS tapered thread plug
4. Adjustable Housing Material: Cast iron with threads.
5. Frame and Cover: Round polished scoriated nickel-bronze, copper alloy.

B. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Body Material: Cast iron.
3. Closure: Gas and watertight ABS tapered thread plug
4. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group

2. Body Material: Cast iron.
3. Seepage Flange: Required.
4. Anchor Flange: Required.
5. Clamping Device: Required

6. Outlet: Bottom.
7. Sediment Bucket: Required as shown on the drawings.
8. Top or Strainer Material: Nickel bronze except cast iron for drains as noted.
9. Top of Body and Strainer Finish: Polished bronze.
10. Top Shape: Round except rectangular for drains as shown on the drawings.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
   1. Coordinate flashing of vents through roof and other roof penetrations with the type of roof provided.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.

B. Sleeve Flashing Device:

   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.

C. Stack Flashing Fittings:

   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

2.6 FLASHING MATERIALS

A. Flashing materials and methods shall be consistent with the waterproofing membrane being installed.:

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack and roof drain leader.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

K. Install traps on plumbing specialty drain outlets.

L. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

B. Set flashing on floors and roofs in solid coating of bituminous cement.

C. Secure flashing into sleeve and specialty clamping ring or device.

D. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.

E. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess. Coordinate flashing method with roof system.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

END OF SECTION 221319

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Household, storage electric water heaters.
2. Commercial, storage electric water heaters.
3. Water heater accessories.

B. Building Automation System: Provide control interface with the BAS so that the system is monitored by the BAS.

1.2 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Operation and maintenance data.

C. Warranty.

1.3 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. ASHRAE/IESNA-90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

C. Comply with NCSBC

D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Period(s): From date of Substantial Completion:

a. Household Electric Water Heaters: 10 years.
b. Commercial Electric Water Heaters: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Storage, Electric Water Heaters:
a. Bradford White Corp.
b. Lochinvar Corp.
c. Patterson-Kelley Co.
d. Rheem Manufacturing Co.; Ruud Water Heater Div.
e. Smith: A. O. Smith Water Products Co.
f. State Industries.
g. Equal products as prior approved.

2. Compression Tanks:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Smith: A. O. Smith; Aqua-Air Div.
d. State Industries.
e. Wessels Co.
f. Equal products as prior approved.

2.2 STORAGE, ELECTRIC WATER HEATERS

A. Description: Comply with UL 1453.

B. Storage Tank Construction: ASME-code for sizes 120 gallons and larger Non-ASME-code steel for smaller sizes with 150-psig working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.

a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.

2. Interior Finish: Glass lined with materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
4. Jacket: Steel, with enameled finish.

C. Heating Elements: Electric, screw-in or bolt-on, immersion type arranged in multiples of three.
1. Temperature Control: Adjustable thermostat.
2. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.

D. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

E. Anode Rods: Factory installed, magnesium.

F. Dip Tube: Factory installed.

2.3 COMPRESSION TANKS

A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

B. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.

C. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.

D. Tank Exterior Finish: Manufacturer's standard, unless finish is indicated.

2.4 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.

B. Vacuum Relief Valves: Comply with ASME PTC 25.3. Furnish for installation in piping.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

C. Install pressure relief valves in water piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

D. Install vacuum relief valves in cold-water-inlet piping.

E. Install thermometers on water heater inlet and outlet piping. Refer to Division 22 Section "Meters and Gages" for thermometers.

F. Provide interface with the BAS so that the BAS will monitor the system.

3.2 CONNECTIONS

A. Install piping adjacent to machine to allow service and maintenance.

B. Make connections with dielectric fittings where piping is made of dissimilar metal.

3.3 FIELD QUALITY CONTROL

A. In addition to manufacturer's written installation and startup checks, perform the following:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Check for piping connection leaks.
3. Check for clear relief valve inlets, outlets, and drain piping.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Faucets
2. Fixture supports.
3. Water closets.
4. Lavatories.
5. Sinks.
6. Drinking Fountains

1.2 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

C. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

PART 2 - PRODUCTS

2.1 FAUCETS

A. Lavatory Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Chicago Faucets.
    b. Zurn.
    c. T & S Brass and Bronze Works, Inc.
2. Manufacturers: Hands Free Faucets subject to compliance with requirements, pr4ovide products by one of the following:
    a. T & S Brass
    b. Zurn
    c. Sloan

2.2 FLUSH VALVES

A. Flushometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Sloan Valve Company.
    b. Zurn Plumbing Products Group; Commercial Brass Operation.

2.3 TOILET SEATS

A. Toilet Seats:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. American Standard Companies, Inc.
    b. Bemis Manufacturing Company.
    c. Church Seats.
    d. Kohler Co.
    e. Olsonite Corp.

2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
    b. McGuire Manufacturing Co., Inc.
    c. Plumberex Specialty Products Inc.
    d. TRUEBRO, Inc.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.5 FIXTURE SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Josam Company.
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
5. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod III or lavatory carrier with hanger plate and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet equal to Smith model 0700.
2. Accessible-Fixture Support: Include rectangular steel uprights.

C. Sink Supports:

1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod or III, sink carrier with hanger plate and exposed arms for sink-type fixture. Include steel uprights with feet.

2.6 WATER CLOSETS

A. Water Closets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler
b. American Standard Companies, Inc.
c. Zurn

2.7 LAVATORIES

A. Lavatories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler Co
b. American Standard Companies, Inc.
c. Zurn

2.8 KITCHEN SINKS

A. Kitchen Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler Co.
b. Elkay Manufacturing Co.
c. Just Manufacturing Company.
d. American Standard

2.9 SERVICE SINKS

2.10 MOP SERVICE BASIN

A. Mop Service Basin:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler Co
b. American Standard Companies, Inc.
c. Crane Plumbing, L.L.C./Fiat Products.
d. Acorn
e. Stern/Williams

2.11 HYDRANTS / HOSE BIBBS:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Smith
b. Zurn
c. Woodford
d. Prier

2.12 WATER COOLERS / DRINKING FOUNTAINS

A. High Low stainless-steel wall mounted units:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkay
b. Haws
c. Halsey Taylor

2.13 FIXTURE STOP VALVES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. McGuire
    b. Zurn
    c. Brass Craft

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

    1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
    2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
    3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.

E. Install fixtures level and plumb according to roughing-in drawings.

F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

G. Install flushometer valves for accessible water closets with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

H. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

I. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

J. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.

K. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.3 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

3.5 PLUMBING FIXTURE SCHEDULE

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified below and in other Part 2 articles.

P-1 Water Closet: White vitreous china, floor mounted, exposed hands free flush valve type, siphon jet action, 1 1/2" top spud, elongated bowl, 1.6 gallon flush, Kohler Wellcome Model K-96053, Bemis 1955SSCT commercial toilet seat with stainless steel check hinges, flush valve Zurn ZER6000AV-TM-WS1-YJ hands free operation, manual override button, battery operated, split ring pipe support, bolt caps, and waxed seal.

P-2 Water Closet: ADA compliant, white vitreous china, floor mounted, exposed hands free flush valve type, siphon jet action, 1 ½" top spud, elongated bowl, 1.6 gallon flush, 16 ½" bowl height, Kohler Highcliff Model K-96057, Bemis 1955SSCT commercial toilet seat with stainless steel check hinges, flush valve Zurn ZER6000AV-TM-WS1-YJ hands free operation, manual override button, battery operated, split ring pipe support, bolt caps, and waxed seal. Coordinate flush valve height and location with grab bars.

P-3 Urinal: ADA compliant, white vitreous china urinal, 3/4" top spud, 1/8 gallon flush, Kohler K4991-ET high efficiency Urinal system with Zurn ZER6003AV-TM-ULF-YK hands free flush valve with manual override button and battery operation, internal flow regulator, in-line filter, high pressure vacuum breaker, adjustable tailpiece, top spud connection, and 2 inch outlet. Zurn carrier with supply pipe support. Mount lip 16 inches AFF.

P-4 Lavatory: Under mount by General Contractor. McGuire 8902 (1 1/4" X 1 1/2") P-trap and wall bend, McGuire No. BV2165 ball valve angle stops and chromed copper flexible risers. McGuire 155WC grid strainer, and 1 1/4" offset tailpiece. Provide Zurn Aqua Sense Sensor faucet model Z6950-XL-S-IM-F-MV-0.5 GPM battery power supply, integral side mixer, cast brass with polished chrome finish, 0.5 gpm aerator, single hole deck mounted, ADA complaint, infrared sensors, low battery indicator, commercial battery and mounting hardware. Provide McGuire ProWrap seamless white pre-molded antimicrobial vinyl insulation kit on tailpiece, p-trap, and supplies for fixtures for the disabled. Install to comply with ADA.

P-5 Lavatory: Under mount by General Contractor. McGuire 8902 (1 1/4" X 1 1/2") P-trap and wall bend, McGuire No. BV2165 ball valve angle stops and chromed copper flexible risers. McGuire 155WC grid strainer, and 1 1/4" offset tailpiece. Provide Zurn Z81000-XL single handle lavatory faucet with 1.5 gpm vandal resistant aerator cast brass with polished chrome finish. Provide McGuire Pro-Wrap seamless white pre-molded antimicrobial vinyl insulation kit on tailpiece, p-trap, and supplies for fixtures for the disabled. Install to comply with ADA.

P-6 Mop Basin: Fiat model TSB-3000 (24”x24”x12”) molded stone Service basin with stainless steel wall guards, faucet T & S Model B-0665-BSTP chrome plated with vacuum breaker, integral stops, pail hook and 3/4" hose thread on spout. Hose and hose bracket No. 832-AA, mop hanger No. 889-CC. Mount mop hanger on opposite wall from faucet.

P-7 Electric Water Cooler: Two level, ADA compliant Elkay Model No. EZSTL8WSLK barrier-free, bi-level design with EZH20 bottle filling station, 8.0 gph capacity@50 degrees, front and side controls, stainless steel basin, gray granite cabinet, wall mounted with embossed bubbler pad, and abrasion resistant flexi-guard safety bubbler. Bottle filling unit shall include an electronic sensor for touchless activation with auto 20 second shut-off timer. Provide McGuire 8902 1 ¼” cast brass p-trap with wall bend, McGuire LFBV2165 ball valve angle supply stops with chromed copper flexible supply tubes. Mount unit 34” above finished floor for lower bowl.

P-8 Hose Bibb: Mount in mechanical rooms or where shown (with floor drain) hose bibb as manufactured by Woodford Faucet, Model No. 24 complete with vacuum breaker, ¾” hose threaded outlet with lock shield cap and loose tee key.

P-9 Anti-Freeze Hydrant (AFH): Anti-freeze hydrant (AFH) shall be anti-siphon, automatic draining, wall box hydrant complete with integral backflow preventer, brass finished box, non-freeze type with bronze casing, stainless steel stem, all bronze interior parts and non-turning operation and with free-floating compression closure valve, polished brass exterior finish equal to Woodford model B65. Furnish loose key with each hydrant.

END OF SECTION 224000

DIVISION 23

HVAC

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Concrete bases.
10. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

A. Welding certificates.

B. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.

C. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

D. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Show access panels and door locations. Include the following:

1. Planned piping layout, including valve and specialty locations and valve-stem movement.
2. Planned ductwork layout of mechanical rooms and other congested spaces.
3. Clearances for installing and maintaining insulation.
4. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
5. Equipment and accessory service connections and support details.
6. Exterior wall and foundation penetrations.
7. Fire-rated wall and floor penetrations.
8. Sizes and location of required concrete pads and bases. Coordinate floor drain locations.
9. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
10. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
11. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

E. Samples: Of color, lettering style and other graphic representation required for each identification material and device.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting

electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Deliver ductwork and fittings with ends covered with plastic. Maintain ductwork completely sealed and protected from all construction all dust, dirt, and other foreign materials.

C. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION OF TRADES

A. Check, verify and coordinate work with other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with the building structure or other trades.

B. Drawings and specifications are necessarily schematic in nature and cannot describe completely all situations that might be encountered in the field. It is the responsibility of the contractor to familiarize himself with the scope of work required and include all work indicated or reasonably implied by the contract documents.

C. Layout the work to prevent conflict with, and to co-ordinate with work of other trades. Systems shall generally be run in a rectilinear fashion.

D. Each trade is responsible for the coordination of their work with all other work at the site prior to beginning in each area.

E. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

F. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

G. Coordinating space requirements, supports, 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; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

H. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.9 DIVISION OF WORK (Division 23/26)

A. This section delineates the division of work between Division 23 and Division 26.

B. Specific work to be done under Division 26 is hereinafter listed or described. All other work necessary for the operation of Division 23 equipment shall be performed under Division 23.

C. All individual motor starters for mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Division 23 unless indicated as a part of a motor control center. Motor starters for mechanical equipment provided in motor control centers shall be furnished under Division 26.

D. Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter or disconnect switch. Under Division 26 line side terminations shall be provided. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Division 23.

E. Duct smoke detectors shall be furnished and wired by Division 26, installed by Division 23. Fire alarm AHU shut down circuits shall be wired from the fire alarm control panel to a ter-

mination point, adjacent to the AHU control, under Division 26. AHU control wiring from the termination point to the equipment shall be under Division 23.

F. All relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote pushbutton stations, emergency break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 23 shall be furnished, installed and wired under Division 23.

G. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 23.

H. Roof exhaust fans with built-in disconnects provided under Division 23 shall be wired under Division 26 to the line side of the disconnect switch. A disconnect switch shall be provided under Division 26 if the fan is not provided with a built-in disconnect switch. In this case wiring from the switch to the fan shall be under Division 23.

I. The sequence of control for all equipment shall be as indicated on the Division 23 Drawings and/or specified in Section, HVAC Control System.

J. All sprinkler flow and tamper switches shall be furnished and installed under Division 23, and wired under Division 26.

K. Where electrical wiring is required by trades other than covered by Division 26, specifications for that section shall refer to same wiring materials and methods as specified under Division 26. No Exceptions.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: Chrome plated

D. Split-Casting, Cast-Brass Type: Chrome plated with concealed hinge and set screw.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs. In upper level mechanical rooms, extend floor sleeves to six inches above finish floor.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.4 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION 230500

SECTION 230505 – ROOF CURBS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Roof curbs.

2. Equipment supports

3. Housekeeping pads.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

1.4 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Roof Curbs and Equipment Supports:

a. Pate Co.(The)

b. Loren Cook Company.

c. Roof Products & Systems Corp.

d. ThyCurb, Inc.

e. Vent Products Co., Inc.

2.2 MATERIALS, GENERAL

A. Aluminum Sheet: ASTM B 209 for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.

B. Extruded Aluminum: ASTM B 221 alloy 6063-T52 or alloy and temper required to suit structural and finish requirements, with mill finish, unless otherwise indicated.

C. Galvanized Steel Sheet: ASTM A 653/A 653M with G90 coating designation; commercial quality, unless otherwise indicated.

D. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated, not less than 1 ½".

E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.

F. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

2.3 ROOF CURBS

A. General: Provide insulated roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch- thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.

1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.

2. Provide manufacturer's standard rigid or semirigid insulation where indicated.

3. Provide formed cants and base profile coordinated with roof insulation thickness.

4. Fabricate units to provide a minimum clearance of 10 inches between the top of the finished roof surface and the top of the wood nailer, continuous around the curb perimeter. The minimum nominal curb height shall be 14 inches, unless otherwise indicated.

5. Sloping Roofs: Fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

6. Insulate curb with 1 ½" thick insulation to provide a continuous thermal envelope.

2.4 EQUIPMENT SUPPORTS

A. General: Provide equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported.

B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile. Fabricate units to minimum height of 14 inches above the finished roof, unless otherwise indicated. Verify roof insulation thickness at the equipment locations and provide curbs that provide minimum code required height above roof surface. Fabricate support units with height tapered to match slope to level tops of units.

C. Provide 3000 psi concrete reinforced with 6x6x6 WWF, housekeeping pads for all slab mounted equipment. Chamfer pad edges 1/2".

2.5 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Provide concrete support pads and concrete housekeeping pads for all slab or grade mounted equipment.

2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

6. Install anchor bolts to elevations required for proper attachment to supported equipment.

7. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

8. Use 3000 psi, 28-day compressive-strength concrete and reinforcement. Unless otherwise indicated, reinforcement shall be 6x6x6 WWF. Chamfer pad edges 1/2".

2.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

2.7 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Place grout, completely filling equipment bases.

E. Place grout on concrete bases and provide smooth bearing surface for equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

B. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 230505

SECTION 230513 - COMMON MOTOR AND CONTROLLER REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 SUBMITTALS

A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

B. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

1.4 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:

a. Magnetic controllers.

b. Multispeed controllers.

c. Reduced-voltage controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.

3. Matched to torque and horsepower requirements of the load.

4. Matched to ratings and characteristics of supply circuit and required control sequence.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply to factory-installed and field-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.

2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

3. All motors operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft currents within the motor and/or its bearings. Motors shall be provided with one shaft grounding ring installed either on the drive end or non-drive end. Grounding rings shall be provided and installed by the motor manufacturer or contractor and shall be installed in accordance with the manufacturer's recommendations.

2.2 MOTOR CHARACTERISTICS

A. Motors 1/2 HP and Larger: Three phase.

B. Motors Smaller Than 1/2 HP: Single phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open drip proof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Open drip proof for general use, weatherproof, explosion proof, etc., as required for special duty application.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Comply with requirements of the NCSBC and EPACT and NEMA Table 12.6C, but at a minimum provide Premium efficiency motors.

Minimum Full Load Efficiency Open Motors				Minimum Full Load Efficiency Enclosed Motors			
Rating HP	3600 RPM 2-POLE	1800 RPM 4-POLE	1200 RPM 6-POLE	Rating HP	3600 RPM 2-POLE	1800 RPM 4-POLE	1200 RPM 6-POLE
1		82.5	80.0	1	75.5	82.5	80.0
1.5	82.5	84.0	84.0	1.5	82.5	84.0	85.5
2	84.0	84.0	85.5	2	84.0	84.0	86.5
3	84.0	86.5	86.5	3	85.5	87.5	87.5
5	85.5	87.5	87.5	5	87.5	87.5	87.5
7.5	87.5	88.5	88.5	7.5	88.5	89.5	89.5
10	88.5	89.5	90.2	10	89.5	89.5	89.5
15	89.5	91.0	90.2	15	90.2	91.0	90.2
20	90.2	91.0	91.0	20	90.2	91.0	90.2
25	91.0	91.7	91.7	25	91.0	92.4	91.7
30	91.0	92.4	92.4	30	91.0	92.4	91.7
40	91.7	93.0	93.0	40	91.7	93.0	93.0
50	92.4	93.0	93.0	50	92.4	93.0	93.0
60	93.0	93.6	93.6	60	93.0	93.6	93.6
75	93.0	94.1	93.6	75	93.0	94.1	93.6
100	93.0	94.1	94.1	100	93.6	94.5	94.1
125	93.6	94.5	94.1	125	94.5	94.5	94.1
150	93.6	95.0	94.5	150	94.5	95.0	95.0
200	94.5	95.0	94.5	200	95.0	95.0	95.0

C. Stator: Copper windings, unless otherwise indicated.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.

2. Temperature Rise: Matched to rating for Class B insulation.

3. Insulation: Class H.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

5. Shaft grounding rings.

2.5 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, sleeve type for other single-phase motors.

2.6 CONTROLLERS AND CONTROLS:

A. Controllers shall conform to adopted standards and recommended practices of the Industrial Control Standards of the National Electrical Manufacturers Association and the standard for Industrial Control Equipment of the Underwriters Laboratories, Inc. Single phase motors shall be provided with integral overload protection.

B. Two (2) speed, three phase motors shall be one winding consequent pole type.

C. Magnetic starters for motors 50 hp and smaller shall be full voltage, across the line type with undervoltage release for manual or automatic operation and shall break all phases on 3 phase starters.

D. Starters for motors 60 hp and above shall be reduced voltage type. Starters shall be provided with start-stop pushbuttons mounted on cover unless controlled by hand-off-automatic device. Hand-off-automatic device shall not be wired to override safety device interlocks on starter mounted on or adjacent to starter except where indicated on plans. If selector is mounted remotely, provide test start pushbutton on starter. All auxiliary contacts required for interlocking purposes shall be furnished and installed with starter. All manual motor starters shall be quick-make, quick-break, toggle action types with one-piece melting alloy type thermal units and pilot light.

E. Starters shall be provided with proper size thermal elements which shall be of one-piece, interchangeable construction. The starter shall not operate with any element removed. All starters installed outdoors shall be provided with ambient temperature compensating motor overload devices. All starter enclosures shall be NEMA 1, indoors and NEMA 3R in exterior areas, unless noted otherwise.

F. All starters and pushbutton stations shall be provided with labels as specified under identification designating service for which starter is used. Plate shall be firmly attached to starter or wall mounted adjacent to starter.

G. Provide thermal element selection chart on the inside of each starter door.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.

2. Test interlocks and control features for proper operation.

3. Verify that current in each phase is within nameplate rating.

3.2 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.3 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 230513

SECTION 230514 – VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes solid-state, PWM, VFDs for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. BMS: Building management system.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFD: Variable frequency drive.

1.4 SUBMITTALS

A. Product Data: For each type of VFD, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. Shop Drawings: For each VFD.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Nameplate legends.
c. Short-circuit current ratings of integrated unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFD. Provide schematic wiring diagram for each type of VFD.

C. Operation and Maintenance Data: For VFDs, all installed devices, and components to include in emergency, operation, and maintenance manuals.

1. Routine maintenance requirements for VFDs and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 COORDINATION

A. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

C. Coordinate features of VFDs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each VFD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB
2. Danfoss
3. Yaskawa
4. Eaton

2.2 VARIABLE FREQUENCY DRIVES

A. Description: NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:

1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent
2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Capable of driving full load, under the following conditions, without derating:

    a. Ambient Temperature: 0 to 40 deg C.
    b. Humidity: Less than 90 percent (non-condensing).
    c. Altitude: 3300 feet .

4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent.
6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
7. Starting Torque: 100 percent of rated torque or as indicated.
8. Speed Regulation: Plus or minus 1 percent.
9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

E. Control Signal Interface: Provide VFD with the following:

1. Electric Input Signal Interface: A minimum of 3 analog inputs (0 to 10 V or 0/4-20 mA) and 8 programmable digital inputs.
2. Output Signal Interface:

a. A minimum of 2 programmable analog output signals and two programmable relay outputs.

F. Communications: Provide an RS485 interface.

G. Integral Disconnecting Means: NEMA AB 1, service disconnect with lockable handle.

H. Bypass: Provide bypass with internal line bus reactor and under-over voltage protection for bypass control circuit.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.
5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.
2. Snubber networks to protect against malfunction due to system voltage transients.
3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
4. Motor Overload Relay: Adjustable and capable of NEMA 250 performance.
5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
6. Instantaneous line-to-line and line-to-ground overcurrent trips.
7. Loss-of-phase protection.
8. Reverse-phase protection.
9. Short-circuit protection.
10. Motor overtemperature fault.
11. Integral input line reactor option to lower total current harmonic distortion to prevent nuisance main breaker tripping and extend life of motor.
12. Bypass with the bypass control circuitry protected by undervoltage relay protection

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

L. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

M. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

N. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

O. Control Signal Interface: Provide VFD with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

    a. 0 to 10-V dc.
    b. 0-20 or 4-20 mA.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.
    e. RS485.
    f. Keypad display for local hand operation.

3. Output Signal Interface:

    a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:

        1) Output frequency (Hz).
        2) Output current (load).
        3) DC-link voltage (VDC).
        4) Motor torque (percent).
        5) Motor speed (rpm).
        6) Set-point frequency (Hz).

4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

    a. Motor running.
    b. Set-point speed reached.
    c. Fault and warning indication (overtemperature or overcurrent).
    d. PID high or low speed limits reached.

P. Communications: Provide an RS485 interface allowing VFD to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of

VFD to be programmed via BMS control. Provide capability for VFD to retain these settings within the nonvolatile memory.

Q. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.

2.3 ENCLOSURES

A. NEMA 1

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Standard Displays:

1. Output frequency (Hz).
2. Set-point frequency (Hz).
3. Motor current (amperes).
4. DC-link voltage (VDC).
5. Motor torque (percent).
6. Motor speed (rpm).
7. Motor output voltage (V).

F. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFDs before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

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

3.2 APPLICATIONS

A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFD mounting surface.

B. Install VFDs on concrete bases.

C. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 IDENTIFICATION

A. Identify VFDs, components, and control wiring according to Division 26 Section.

B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.5 CONNECTIONS

A. Ground equipment.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 STARTUP SERVICE

A. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

B. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.8 CLEANING

A. Clean VFDs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFDs.

END OF SECTION 230514

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design heavy-duty steel trapezes and/or support channels for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.5 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

B. All bracket, clamp and rod sizes indicated are minimum sizes only. The installing trade shall be responsible for structural integrity of all supports. All structural hanging materials shall have a safety factor of 5 built in and shall comply with MSS Standard SP-69.

C. All hangers, supports, fasteners, etc. for outdoor installation shall be hot dip galvanized, indoor hangers may be painted or galvanized. All hanger rod shall be hot dip galvanized or cadmium plated.

D. Supports for uncovered copper tubing shall be especially designed for copper tubing, shall be of exact outside diameter of tubing and shall be copper plated

E. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.2 MISCELLANEOUS MATERIALS

A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.

2. Properties: Nonstaining, noncorrosive, and nongaseous.

3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections. Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

Description	Type
Insulation Protection Shield	40

Pipe saddle	39
Clevis hanger	1
Roller hanger	43
Clevis	14
Eye Nut	17
Eye Socket	16
U-bolt	24
Copper Tubing Hanger	10
Beam Clamp	23
Pipe Roller Stand	44 and 46
Pipe Clamp	4 and 3
Riser Clamp	8
Center Load Beam Clamp	21
Wall Bracket	32 and 33
Welded Beam Attachment	22
Concrete Insert	18
Turnbuckle	13

C. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Supports, anchors, hangers and guides per MSS SP-69 shall be provided for all horizontal and vertical piping. Hangers shall be so arranged as to prevent excessive deflection and avoid excessive bending stresses. Clevis type hangers shall be used for support of "cold" or ambient temperature piping systems, provide galvanized insulation shields with flared ends for insulated piping. Roller type supports shall be used for hot pipes subject to axial movement. Supports

shall be braced so that movement occurs in roller rather than support rods. Provide beam clamps, turnbuckles, struts, channels, angle iron, and miscellaneous supports as required for a complete installation. Pipe hangers shall be installed no further than 24" from any change of direction. Contractor shall bear all responsibility for materials and workmanship as described in this section and shall make sure that all hangers and supports are properly and permanently connected to building structure.

C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.

1. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 PAINTING

A. Paint all hanger rings, rods, beam clamps, etc. where exposed to view.

B. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION 230529

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Variable-volume air systems.
b. Constant-volume air systems.

2. Testing, Adjusting, and Balancing Equipment:

a. Air-handling units
b. Motors.
c. Condensing units.

3. Testing, adjusting, and balancing existing systems and equipment.
4. Duct leakage tests.
5. Control system verification.

B. See Section 3.1, paragraph below for Approved Testing, Adjusting and Balancing Agencies.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. LEED Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation indicating that work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
2. TAB Report for Prerequisite EA 2: Documentation indicating that work complies with ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 90 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.

5. Dates of calibration.

1.7 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.8 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following:

1. B.E.S.T.
2. Air Flow Experts
3. Palmetto
4. Phoenix

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.

d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect (Engineer) for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's

recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
    g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.

b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

    a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
    b. Re-measure and confirm that total airflow is within design.
    c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
    d. Mark final settings.
    e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
    f. Verify tracking between supply and return fans.

3.8 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.10 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Mechanical Contractor,

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.11 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.12 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.13 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Fan drive settings including settings and percentage of maximum pitch diameter.
    e. Settings for supply-air, static-pressure controller.
    f. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Pipe and valve sizes and locations.
4. Terminal units.

5. Balancing stations.
6. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm (L/s).
    j. Return airflow in cfm (L/s).
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.
    b. Location.
    c. Coil type.

d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm .
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Electric-Coil Test Reports: For electric duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft.
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Manufacturer's serial number.
    f. Arrangement and class.
    g. Sheave make, size in inches, and bore.
    h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. System and air-handling-unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F.
    d. Duct static pressure in inches wg.
    e. Duct size in inches.
    f. Duct area in sq. ft.
    g. Indicated airflow rate in cfm.
    h. Indicated velocity in fpm.
    i. Actual airflow rate in cfm.
    j. Actual average velocity in fpm.
    k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.

L. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - HVAC DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes semi-rigid and flexible duct, and plenum insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Removable insulation sections at access panels.

2. Application of field-applied jackets.

3. Applications at linkages for control devices.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Fiberglass Blanket Thermal Insulation: Formaldehyde-free, Greenguard Certified. Glass fibers bonded with a thermosetting resin, 0.75 lbs. per cubic foot density, thermal conductivity (K value) no more than 0.29. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

B. Formaldehyde-free, Greenguard Certified. Fiberglass Board (Rigid) Thermal Insulation: Glass fibers bonded with a thermosetting resin, 3.0 lbs. per cubic foot density, thermal conductivity (K value) no more than 0.23. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

C. Internal duct lining shall not be used except where specifically indicated on drawings.

2.2 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..

C. Canvas Cloth: Woven canvas fabrics, plain weave, presized a minimum of 8 oz./sq. yd.

D. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

E. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.

2. PVC Jacket Color: White.

F. Aluminum Jacket: .032” thick, 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.

1. Finish: Stucco embossed finish.

2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.

2.3 VAPOR RETARDERS

A. Aluminum foil reinforced with fiberglass scrim laminated to UL rated kraft. Permeance shall not exceed .02 perms.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

B. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

C. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

D. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

E. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

3.3 FIBERGLASS INSULATION APPLICATION

A. Blanket Applications for Ducts and Plenums: Secure insulation with adhesive and anchor pins and speed washers. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins.

3.4 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth or canvas cloth jacket, where indicated, directly over insulation vapor barrier.

3.5 DUCT SYSTEM APPLICATIONS

A. Materials and thicknesses for systems listed below shall comply with the requirements of the North Carolina State Energy Code and shall be not less than the “R” values specified in schedules at the end of this Section.

B. In addition to any acoustic liner specified in Section 233113 Metal Ducts and/or indicated on the drawings, insulate the following plenums and duct systems:

1. Indoor concealed supply and outside-air ductwork.

2. Indoor exposed supply and outside-air ductwork.

3. Indoor concealed and exposed return air duct located in non conditioned spaces such as Mechanical Equipment Rooms and ventilated attics.

4. Outdoor exposed supply and return and outside air ductwork.

3.6 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

A. Service: Round, supply-air ducts, concealed.

1. Material: **Fiberglass blanket**

2. Thickness: **Apx. 2.25 inches (minimum R value 6.0)**

3. Number of Layers: **One**

4. Field-Applied Jacket: **Foil and paper**.

5. Vapor Retarder Required: **Yes**.

B. Service: Round, outside-air ducts, concealed.

1. Material: **Fiberglass blanket**

2. Thickness: **Apx. 2.25 inches (minimum R value 6.0)**

3. Number of Layers: **One**

4. Field-Applied Jacket: **Foil and paper**.

5. Vapor Retarder Required: **Yes**.

C. Service: Rectangular, supply-air ducts, concealed.

1. Material: **Fiberglass blanket**

2. Thickness: **Apx. 2.25 inches (minimum R value 6.0)**

3. Number of Layers: **One**

4. Field-Applied Jacket: **Foil and paper**.

5. Vapor Retarder Required: **Yes**.

D. Service: Rectangular, outside-air ducts, concealed.

1. Material: **Fiberglass blanket**

2. Thickness: **Apx. 2.25 inches (minimum R value 6.0)**

3. Number of Layers: **One**

4. Field-Applied Jacket: **Foil and paper**.

5. Vapor Retarder Required: **Yes**.

E. Service: Round, supply-air ducts, exposed.

1. Material: **Fiberglass blanket**

2. Thickness **Apx. 3 inches (minimum R value 8.3)**

3. Number of Layers: **One**

4. Field-Applied Jacket: **Glass or Canvas Cloth Indoors; Aluminum Outdoors.**

5. Vapor Retarder Required: **Yes**.

F. Service: Round, outside-air ducts, exposed.

1. Material: **Fiberglass blanket**

2. Thickness: **Apx. 3 inches (minimum R value 8.3)**

3. Number of Layers: **One**

4. Field-Applied Jacket: **Glass or Canvas Cloth**

5. Vapor Retarder Required: **Yes**.

G. Service: Rectangular, supply- and return-air ducts, exposed.

1. Material: **Fiberglass board (rigid)**

2. Thickness: **Apx. 3 inches (minimum R value 8.3)**

3. Number of Layers: **One**

4. Field-Applied Jacket: **Glass or Canvas Cloth**.

5. Vapor Retarder Required: **Yes**.

H. Service: Rectangular, outside-air ducts, exposed.

1. Material: **Fiberglass board (rigid)**

2. Thickness: **Apx. 3 inches (minimum R value 8.3)**

3. Number of Layers: **One**

4. Field-Applied Jacket: **Glass or Canvas Cloth**.

5. Vapor Retarder Required: **Yes**.

END OF SECTION 230700

SECTION 230706 –REFRIGERANT AND CONDENSATE PIPE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

B. Related Sections include the following:

1. Division 23 Section "Duct Insulation" for insulation for ducts and plenums.
2. Division 23 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A commercial/industrial “Insulation Contractor” specializing and regularly engaged in the installation of HVAC and Plumbing systems insulation. **Installation by an HVAC contractor is not acceptable.** Skilled mechanics that have successfully completed an apprenticeship program or another craft training program.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Polyethylene or Polymer insulations are not acceptable. Comply with ASTM C 534, Type I for

tubular materials and Type II for sheet materials. Insulation shall be AP/Armaflex, or equal by Aeroflex, RBX or other approved by Engineer.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

2.2 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Smooth or Stucco-embossed finish, 0.016 inch thick.
2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.3 ACCESSORIES AND ATTACHMENTS

A. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.
4. Brass: 0.010 inch thick.
5. Nickel-Copper Alloy: 0.005 inch thick.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.2 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

C. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

D. Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

3.3 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

3.4 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

3.5 FIELD QUALITY CONTROL

A. Insulation applications will be considered defective if random sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

3.6 INSULATION APPLICATION SCHEDULE, GENERAL

A. Materials and thicknesses for systems listed below shall comply with the requirements of the North Carolina State Energy Code and shall be not less than the “thicknesses specified below.

3.7 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Refrigerant Piping.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Flexible Elastomeric Thermal Insulation
3. Insulation Thickness: Apply the following insulation thicknesses:
   Pipe size 1" I.P.S. and below..... 1/2"
   Pipe size 1¼” to 2” .... 3/4"
4. Vapor Retarder Required: Yes
5. UV paint on exterior insulation

B. Service: Condensate drain piping.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Flexible Elastomeric Thermal Insulation
3. Insulation Thickness: Apply the following insulation thicknesses:
   Pipe size 1" I.P.S. and below..... 1/2"
   Pipe size 1¼” to 2” .... 3/4"
4. Vapor Retarder Required: Yes
5. UV paint on exterior insulation

3.8 EXTERIOR INSULATION AND JACKET APPLICATION SCHEDULE

A. This application schedule is for aboveground insulation outside the building.

1. Piping shall be insulated same as interior piping plus be completely covered with a weatherproof field applied aluminum jacket system.

END OF SECTION 230706

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls. The Building Automation System for the existing building is Johnson Controls.

1.2 SYSTEM FEATURES AND ARCHITECTURE

A. The controls system shall be capable of integrating multiple building functions including equipment supervision and control, alarm management, energy management and historical data collection.

B. The system shall be a DDC Web-Based, Open Protocol Building Automation System. The system shall be configured as a distributed processing network of direct digital control (DDC) panels. The system shall be completely modular and stand-alone in both hardware and software and allow for expansion in both function and capacity. Systems requiring a host computer processor for any of the system control operations shall not be acceptable.

C. The system interface allows those with the correct username and password the ability to control the facility from any remote location or from within the same facility as long as they have system wired or wireless Internet connectivity. The software is a standard web browser such as Microsoft Internet Explorer or comparable web browser. System must be capable of unlimited simultaneous users (unique usernames and passwords) and unlimited points. Systems that are not unlimited or require seat licensing and/or adding additional server hardware shall not be acceptable.

D. System shall be ‘web-based system’ accessible via the internet by authorized users, and shall utilize open protocol architecture with open protocol language. BACnet is the preferred protocol. All programmable logic shall be exposed and editable by authorized users and any software necessary for editing programmable logic shall be provided.

E. System graphics shall include dynamic color screens displaying building and HVAC system diagrams with real time values. All graphics shall be exposed and editable by authorized users and any software necessary for editing graphics shall be provided. All points shall be exposed in the BAS up to the network level using BACnet protocol.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Each control device labeled with setting or adjustable range of control.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer installed and field-installed wiring.
3. Details of control panel faces, including controls, instruments, and labeling.
4. Written description of sequence of operation.
5. Schedule of dampers including size, leakage, and flow characteristics.
6. Schedule of valves including leakage and flow characteristics.
7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
8. Listing of connected data points, including connected control unit and input device.
9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
10. System configuration showing peripheral devices, batteries, power supplies, diagrams, and interconnections.

C. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals in electronic format.
2. Program Software Backup in electronic format.
3. Device address list.
4. Software license required by and installed for DDC workstations and control systems.

D. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or monitoring and control revisions.

E. Maintenance Data: For systems to include in maintenance manuals. Include the following:
1. Maintenance instructions and lists of spare parts for each type of control device.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Calibration records and list of set points.

F. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer with at least 10 years of experience who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.

1.5 WARRANTY and SERVICE

A. Warrant the system to be free from defects in material and workmanship for a period of two (2) years from the date of completion and acceptance of the work by the owner. Any defects shall be repaired or replaced, including materials and labor at no cost to the owner.

B. Provide one (1) year of maintenance service for the HVAC controls system to begin concurrently with the 1st year of warranty. Service shall include inspection and adjustment of

all operating controls and components. The service shall be performed every 3 months and documentation of service shall be provided to Facilities Operations.

1.6 WIRING

A. Provide all wiring in conduit required for proper system operation, except as noted below. Wiring methods and installation shall conform to appropriate Division 26 sections. All wiring concealed in walls, partitions, above gypsum board ceilings, or where exposed to view, shall be in conduit.

B. Provide all wiring required for proper system operation. See electrical drawings for provisions by the Electrical contractor. Provide all wiring from termination points which may be junction boxes, or spaces in the nearest electrical panel as shown.

1.7 EXTRA MATERIALS

A. Furnish the following extra materials to Facilities Operations at completion

1. 1 sensor of each type (Hydronic, air supply, humidity)
2. 2 zone thermostats

PART 2 – PRODUCTS

2.1. MANUFACTURERS

A. HVAC controls system contractor shall provide a fully integrated system, UL listed, incorporating direct digital control for energy management, equipment monitoring and control as manufactured by:

1. Automated Logic Controls
2. Johnson Controls
3. Schneider Electric
4. Trane

B. Control Supplier shall have full service office within 50 miles of project site. Full service office is defined to be a home office of applications engineers, supervisors and field technicians having all required test and diagnostic equipment.

C. Control Supplier shall be factory authorized agent or dealer of controllers and control hardware.

2.2. DDC EQUIPMENT

A. Gateway Router

1. The Gateway Router is the electronic link between the respective building and the campus network and shares information among all the DDC stand-alone panels within the respective building.

2. The building Gateway Router shall be a networking stand-alone energy management panel enclosed in a sturdy metal enclosure. The microcomputer shall be at the least 32 bit processor. The microcomputer shall utilize a multi-tasking, multi-user operating system. The Gateway Router shall have a battery backup for the clock.

3. The building Gateway Router shall be placed on the control vendor’s Local Area Network (LAN) configuration within the respective building via its controller level

bus. Fault tolerant operation of the Local Area Network shall guarantee that failure in communication or operation of any DDC controllers on the LAN shall not interrupt the communication between remaining units. The Gateway Router shall also be connected to the Campus Wide Area Network via Ethernet connection with communications based on TCP/IP protocol. This connection is via a campus provided, Ethernet data drop.

4. The Gateway Router shall communicate with the network at 1000 bps (Megabit) speed or faster. The Ethernet card shall reside in the Gateway Router module.

B. DDC Controllers Variable Air Volume (VAV) Digital Controller:

1. VAV Controller shall be microprocessor based, Pressure Independent Variable Air Volume Digital Controllers, as shown in the drawings. The VAV DC shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the VAV controller.

2. The VAV controller shall consist of a 16 bit microprocessor, power supply, enclosure, damper actuator, differential pressure transducer, flow station, field terminations, field adjustments and operating/application system software in a single integrated package. Actuator and flow station should be replaceable, each individually.

3. The VAV controller shall have a room sensor with adjustable setpoint except that sensors in public places shall have a blank cover. The room setpoint shall be capable of being set and/or limited from the computer or data host. The room sensors shall contain a push-button for override of unoccupied conditions with adjustable time settings.

4. Each unit shall be capable of performing the following energy management functions and the following dynamic/real time information shall be displayed on the graphics display, utilizing a representative graphic of the mechanical equipment, with all points being editable at the programmable logic level, including, but not limited to:

   a. CFM setpoint
   b. CFM actual
   c. Fan start/stop, fan status, and fan cfm
   d. Damper actuator position
   e. Supply/Source air temperature
   f. Discharge air temperature
   g. Hot water valve position
   h. Static pressure
   i. Space temperature
   j. Separate Cooling and Heating setpoints with setpoint adjust (range adj.)
   k. Cooling and Heating source links
   l. Unoccupied/Occupied indication and next time transition

C. DDC Controllers

1. DDC Controllers (stand-alone) shall be microprocessor-based with a minimum word size of 16 bits. They shall also be multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification.

2. Control of the mechanical systems shall be performed by a field programmable microprocessor based direct digital controller (DDC), which incorporates closed loop control algorithms, all necessary energy management functions, and provides for digital display and convenient local adjustments of desired variables at the controller cabinet. Systems which require the existing user defined data base to be reentered through the operator's terminal after a failure or power interruption shall not be acceptable.

3. Each unit shall be capable of performing the following energy management functions and the following dynamic/real time information shall be displayed on the graphics display, utilizing a representative graphic of the mechanical equipment, with all points being editable at the programmable logic level, including, but not limited to:

   a. Optimal Start/Stop Scheduling
   b. Time of day scheduling with exceptions and holidays
   c. Enthalpy economizer control
   d. Supply air reset
   e. Chilled water reset
   f. Hot water reset
   g. Event initiated programs
   h. Night setback
   i. Chiller/Boiler sequencing
   j. Chiller/Boiler load monitoring
   k. Start/stops, status, temperature control/monitoring
   l. VFD control and monitoring
   m. Unoccupied/Occupied indication and next time transition
   n. Separate Cooling and Heating setpoints with setpoint adjust (range adj.)
   o. Environmental Index/Efficiency index
   p. Energy (electrical, gas, water, etc) monitoring/trending/peak demand
   q. kW Demand monitoring/limiting/trending/peak demand

4. Each DDC shall be capable of performing all specified control functions in a completely independent manner. Additionally, DDCs shall be capable of being networked for single point programming and for the sharing of information between panels and also through the Ethernet network, including, but not limited to, sensor values, calculated point values, control set-points, tuning parameters, and control instructions.

5. Each DDC controller shall include its own microcomputer controller, power supply, input/output modules, termination modules, battery, and spare AC outlet. The battery shall be continuously charged and be capable of supporting all memory for a minimum of 72 hours. Upon restoration of system power, the control unit shall resume full operation without operator intervention.

D. Graphic Display Requirements

1. Provide a windows based software package for the preparation of system dynamic color graphics.

2. This section establishes standards for dynamic color graphic displays as follows.

a. Any operator workstation shall be programmed to display graphical representations of all the mechanical and energy elements with views at the building, floor and room/space levels. Graphics will also display an accurate representation of all mechanical systems and all points shown by the engineering drawings will included/displayed in the graphics.

b. Systems to be displayed include, but not limited to, the air handlers, air terminal units, variable air volume boxes, chillers, boilers, heat converters, pumping systems and similar mechanical devices.

c. Floor plans displays are required and shall indicate the approximate positions of controlled mechanical system elements within the floor layout. At the building and floor levels, graphics will indicate distance from space temperature with thermo-graphics. At the space/room level, temperature will be displayed. At the mechanical/controller level all pertinent setpoints will be editable.

d. All displays shall show real time data.

E. Application Software: Include the following:

1. Input/output capability from any operator station.

2. Operator system access levels via software password with multiple levels of rights/privileges.

3. Database creation and support.

4. Dynamic color graphic displays with full access to graphics and creation/editing software.

5. Configurable alarm processing with multiple email/text messaging alerts using SSL security.

6. Fully accessible/editable programming logic by authorized users with necessary hardware and software to create/edit.

7. Automatic restart of field equipment on restoration of power.

8. Data collection with Trending and Historian (unlimited history) with automated Reporting.

9. Maintenance management.

2.3. CONTROL PANELS

A. Panels shall have hinged doors and be marked with engraved labels. Panels used as a location for mounting control devices shall have a document holder located on the inside of the door.

B. Provide common keying for all panels

C. All heat generating devices shall be located at the top of the panel.

2.4. SENSORS and TRANSMITTERS

A. Humidity Sensors – BAPI (preferred manufacturer)

1. Accurate to +/- 2%

2. Room sensors; 20 – 90 % RH. Cover to match room thermostat.

3. Duct and outside air sensor; 0 – 100% RH

B. Pressure Sensors – Veris (preferred manufacturer)

1. Duct static pressure sensors shall have an accuracy of +/-1% of range

C. Temperature Sensors – BAPI (preferred manufacturer)

1. Platinum or nickel RTD, 10K ohm, type II, accurate to +/-0.2%

2. Outside air sensors shall be shielded from solar radiation.

3. Temperature sensors used in BTU calculations shall be a matched pair with a differential accuracy of +/-0.15F over entire range and supplied by the BTU system manufacturer.

4. Room space sensors may be thermistor type.

D. Current Sensors – Veris (preferred manufacturer)

1. Proof of run for pumps and fans shall be by current sensed devices

2.5. THERMOSTATS

A. Space Thermostats

1. All room thermostats in classrooms and offices shall have exposed setpoint adjustment with software stops (adjustable through the BMS) for minimum and maximum setting initially set between 68 degrees and 75 degrees.

2. All room thermostats in public areas will have concealed setpoint adjustments with blank cover.

3. Insulated mounting bases on exterior walls.

4. Accuracy to +/-0.5%

5. Each thermostat shall be capable of reporting the space temperature and setpoint. In addition, each shall be capable of remote reset by the DDC system.

2.6. CONTROL VALVES and ACTUATORS – Belimo (preferred manufacturer)

A. General

1. All control valves for HVAC equipment within mechanical equipment rooms and central station units shall utilize electronic actuation. Butterfly valves for air handling unit coil control are unacceptable.

2. Preheating and cooling valves shall be software interlocked so that both valves cannot be opened simultaneously except for override.

3. Operator bodies shall be metal.

B. Hydronic Valves

1. Valves shall be sized so that pressure drop across valve is at least 25% of the coil pressure drop at full design flow.

2. Valves shall remain closed (zero leakage) against 100% of the full shutoff head of the pump.

3. High performance butterfly valves shall have adjustable packing, EPDM seat with suitable metal back-up ring, upper and lower shaft thrust bearings, 316 SS one piece shaft and 3166 SS disc with offset shaft/disc design. Valves shall be provide with pneumatic actuator and positioner. Valves and actuators shall be manufactured by the valve manufacturer.

4. Valves shall be two-way and equal percentage.

5. Two-position valves shall be line size.

6. Valve service rating shall be 125 psig or greater except that valves in the campus chilled water piping shall be rated at 250 psig or greater. The shaft to which the actuator(s) is coupled shall be square or hexagonal or round with one side flattened, to achieve secure coupling.

7. Terminal reheat valves and chilled water shall be electric proportional, 4-20 ma or 0– 10 VDC signal with positive positioning mechanism. Floating point or step control is not allowed.

8. Valves shall have stainless steel trim and seat.

2.7. ACTUATORS – Belimo (preferred manufacturer)

a. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action. Spring return for full close-off pressure.

b. Electronic Damper and Large-Valve Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1) Valves: Size for torque required for valve close-off at maximum pump differential pressure.

2) Dampers: Size for running torques and velocity/CFM

2.8. ELECTRIC INSTRUMENTATION

A. General:

1. Electrical devices, switches, and relays shall be UL listed and of type meeting current and voltage characteristics of the project. Outdoor units shall be NEMA 4 with concealed adjustment.

2. Ratings of normally open and closed contacts shall be adequate for applied load

3. Accuracy of devices shall be 1% of scale with adjustable offset unless otherwise specified.

B. Pressure Differential Switches – Veris (preferred manufacturer):

1. Adjustable set point, differential pressure type. Select switches for accuracy, ranges (20 to 80% of operating range) and dead-band to match process conditions, electrical requirements and to implement intended functions.

2. Pressure differential switches for water systems shall be rated for 150 psig unless otherwise noted.

3. Maximum Temperature Rating: 300°F

4. Repeatability: ± 1 %

C. Current Switches – Veris (preferred manufacturer):

1. Induction type sensor clamped over single phase AC electrical power conductor shall be solid state sensor with adjustable threshold and normally, open contacts. Select each current switch for proper operating range of current

   a. Transition current: 75 mA at 1 A setpoint, 2.5 A at 10 A setpoint
   b. Hysteresis: 0.015 A at 1 A setpoint, 0.20 A at 10 A setpoint
   c. Response Time: less than 0.5 seconds

D. Temperature Low Limit Switches (Freezestats):

1. Electric 2 position type with temperature sensing element and manual reset. Controls shall be capable of opening circuit if any one foot length of sensing element is subject to temperature below setting.

2. Sensing element shall not be less than one lineal foot per square foot of coil surface areas. Unless otherwise indicated, calibrate temperature switch setpoint to 38°F.

2.9. ANALOG ELECTRONIC INSTRUMENTATION

A. Direct Insertion Temperature Sensors – BAPI (preferred manufacturer):

1. Sensor assembly shall be direct insertion, suitable for use with water systems,

150 pound class, minimum rating.

2. Sensor shall be RTD, minimum accuracy of ± 0.1% at 32°F.

3. Sheath diameter shall not exceed 5/16". Length shall be such that sheath, containing sensor, projects into process fluid from 2" to 2.5" beyond pipe wall when installed. Material to be 304 or 316 stainless steel. Process coupling to be 3/8" or 1/2" NPT.

4. Connection head to be NEMA 4, cast iron, with screw on cap. Provide internal termination for RTD and wire connection.

5. Provide hot tap assembly and extension. Material to be 304 or 316 stainless steel. Support hot tap at minimum of 2 points to eliminate vibration. Extension shall exceed insulation thickness by 1".

B. RTD Temperature Transmitters – BAPI (preferred manufacturer):

1. Transmitters shall provide 2 wire 4-20 mA or 0-10 V output signal proportional to specified temperature span of transmitter and compatible with DDC equipment.

2. Power Supply Voltage: 10 to 30 VDC/VAC unregulated.

3. Accuracy or Output Error: 0.1 % of span of sensor and transmitter combination.

4. Provide local temperature indicator.

C. Pressure/Differential Pressure Transmitter – Veris (preferred manufacturer):

1. Pressure sensor and integral 4-20 mA or 0-10V transmitter. Select instrument for intended usage (differential pressure, gauge pressure, level, etc.), range, maximum pressure/temperature. Sensor shall be capacitance or strain gauge type. Enclosure to be NEMA 4.

2. Differential pressure transmitters shall have valved manifold for servicing.

3. Diaphragm Material: Stainless Steel or Hastelloy

4. Process Connection: ½" NPT Stainless Steel

5. Power Supply Voltage: 10 – 30 VDC/VAC unregulated

6. Over Pressure: 1000 psig or 2 times maximum operating pressure whichever is greater.

7. Performance:

8. Zero: Zero control shall be continuously adjustable between ± 50% of upper range limit. Total calibrated span and zero adjustment cannot exceed upper range limit. Zero span shall be independently field adjustable with no interaction.

9. Accuracy: ± 0.25% of calibrated span, including effects of linearity, hysteresis,

repeatability dead band.

10. Drift: ± 0.1% of upper limit for 6 months.

11. Power Supply Effect: Less than 0.01% of output span per volt

12. Static Pressure Effect: Zero Error: ± 0.1% of upper range limit per 1000 psi

13. Span Error: ± 0.2% of reading per 1000 psi

14. Temperature Effect: ± (0,025% upper range limit plus 0.125% span) per 50°F.

D. Insertion Type Turbine Flow-meter/Transmitter – Onicon (preferred manufacturer):

1. Provide turbine type flow-meter with hot tap type insertion assembly and microprocessor based transmitter. Selected span shall be not greater than twice design flow range. Select units for 10:1 turndown.

2. Hot tap assembly shall be insertion/extraction type with depth gauge and shutoff valve. Select turbine and body for intended service and pressure/temperature range. Transmitter shall have linear output of 4- 20 mA or 0-10V with nominal 24 VDC/VAC power requirement. Enclosure shall be NEMA 4.

3. Accuracy: ± 0.5% in linear range

4. Repeatability: 0.25% in linear range

a. Construction materials:
   1) Non-wetted Parts: Aluminum

   2) Wetted Parts: 316 Stainless Steel

   3) Turbine: 17-4 pH Stainless Steel with tungsten carbide bearings

5. Transmitter shall be integral mounted on flow meter.

6. Provide remote mounted indicator/transmitter. Indicator shall be ½" LCD or back lit LED type.

E. Air-measuring station – Ebtron (preferred manufacturer):

1. Basis of design: Ebtron GTC116-PC.

F. Current Transformers – Veris (preferred manufacturer):

1. Alternating current transformers shall conform to the latest applicable standards including AEIC, EEI-NEMA, Standards for Instrument Transformers (MSJ-11) and ANSI Standard C57.13 for instrument transformers.

2.10. DAMPERS and ACTUATORS

A. Dampers:

1. Maximum blade width of 8” with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade. Provide low leakage control dampers. Damper leakage rate shall not exceed 10 CFM/sq. ft. at 4" wg. Dampers shall have blade seals and stops. The shaft to which the actuator(s) is coupled shall be square or hexagonal or round with one side flattened, to achieve secure coupling.

2. Provide actuators for all automatic control dampers. Locate damper actuators outside of the air stream. Positioning relays will be provided for each damper section: one each for outside air, return air and relief air.

3. Control dampers used for outside air or exhaust shall be installed a minimum of 6” away from wall penetrations to allow for external mounting of actuators.

4. Throttling operation shall be opposed blade type.

B. Airflow Measuring Damper and Sensors:

1. Provide Tamco/Ebtron Series AIRPIQ / GTC-PC Air Flow Measurement Damper (AFMD) with Ebtron GTC116-PC air flow sensor. Air Measuring Sensors without damper shall be Ebtron GTC116-PC.

2.11. LABELS and TAGS

1. Provide labels for all field devices including sensors, meters, transmitters and relays. Labels shall be plastic laminate and located adjacent to the device.

2. Labels of field devices (both locally and software ID’s) shall be associated with their respective air handler, boiler, chiller, etc.

3. Junction box covers shall be painted yellow and labeled “DDC”

2.12. CONTROL WRING

A. Control wiring shall be in accordance with National Electric Code. Final connection points at devices and panels shall be made at terminal blocks either integral to device or separate terminal blocks mounted inside of control panel enclosures.

B. Refer to Division 26 for conduits and conductors, except as noted.

C. Signal Conductors (24 Volts and Under):

1. No wire smaller than #18 AWG shall be used, except for manufacturer supplied instrument specific wire, or unless otherwise specified. Use 2 wire twisted pair 24 VDC for analog and/or discrete devices. For RTD signal wiring, use #18 AWG stranded, tinned copper twisted/shielded 3 conductor.

2. Conductors not concealed in raceway shall have UL listed plenum rated Teflon insulation.

3. Communication Cable: #22 to 24 AWG twisted, shielded pairs, coaxial cable, or fiber optics for communications between remote control devices. Provide 250 ohm, 5 watt, 0.1 % tolerance dropping resistors as required to get 1 to 5 volt signals in 24 VDC powered loops. Provide isolated instrument grounding system as per manufacturer's recommendations.

D. Transient Voltage Surge Suppression Devices:

1. Devices shall be designed for 120 volt power conditioning devices for electronic equipment. Devices shall be designed, manufactured, tested, and installed in compliance with ANSI/IEEE C62.41 and C62_45, Federal Information Processing Standards Publication 94 (FIPS PUB 94), NEMA, NFPA 70, 75, and 78, and UL 1449 and 1283. Devices must labeled for UL 1449.

2. Provide visual indicator of when surge device has been used.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Control Wiring

1. All control wiring shall be in conduit except where installed above accessible lay-in ceilings, plenum-rated wiring is acceptable. Conduit shall be run parallel or perpendicular to walls and building lines. Wiring concealed in walls, above gypsum board ceilings and soffits, or exposed to view shall be in conduit. Conduit shall be ran parallel or perpendicular to walls and building lines. Junction box covers shall be painted yellow and labeled “DDC”.

2. Wiring and wiring methods shall comply with Division 26.

3. Wires shall be labeled with mechanically prepared labels at their connection point to each apparatus point of connection.

4. Provide all electrical wiring required for complete functional control systems, including power circuit to control panels, both line and low voltage, in accordance with all applicable local codes, and the latest version of National Electric Code and NFPA when applicable.

5. Tag each wire termination at control panels, junction boxes, and remote control devices with unique wire ID number.

6. Control suppliers company standard color codes may be used.

7. Electric signal cables from electronic transmitters to receivers and from controllers to final control elements shall be continuously shielded. Shields shall be grounded at power source end only and floated at the other end. Pay particular attention to floating shields through termination points, maintaining only one single grounding point, and insulating from ground at all other points.

8. Network Communication Cable:

a. Install special cable connectors in accordance with manufacturer's recommendations.

b. Network communication cable shall not be spliced.

3.2. ON-SITE TESTING

A. When installation is complete, perform the following:

1. A 100% field calibration of all sensors and equipment.

2. Verification of each control point by comparing the control command and the field device.

3. Documentation of results shall be provided to the University prior to final acceptance.

3.3. DEMONSTRATION

A. Demonstrate that controls are installed, adjusted and operate as required by the drawings and specifications. This demonstration shall be documented and may be conducted in conjunction with the training of University personnel. The documentation shall identify the item, the person performing the demonstration, date, and the signature of the University's representative. The University's Representative will select the items to be demonstrated.

3.4. ADJUSTMENT AND COMPLETION CHECKLIST

A. After completion of installation, follow checklist procedure defined in checklist submittal to adjust and calibrate all control valves, control actuators, controllers, sensors, and other equipment provided in this contract. Include signed and dated completed checklist in operating and maintenance manuals.

B. Upon completion of work but before final acceptance of the systems, Engineer will verify performance of control loops. Control Supplier shall immediately remedy any deficiencies found. Corrective measures may include modification or addition of equipment and devices, control strategies and/or software program. All corrective modifications made by Control Supplier during warranty periods shall be incorporated and updated in operating and maintenance manuals.

3.5. OWNER TRAINING

A. Provide minimum of 8 hours of on-site training to Owner's representatives. Conduct training sessions during normal business hours after system start-up and acceptance by Owner. Scheduling of training session(s) will be established by Owner. Portions of training may be performed before system is completely operational, but no sooner than one month before system is planned to be fully operational. Final training session shall be held after systems are complete including all graphics programming.

B. Course content shall include, but not limited to, the following topics:

1. Explain control sequences. Include which sensors are used and how output device operates.

2. Explain control drawings and manuals, including symbols, abbreviations, and overall organization.

3. Walk-through project to identify controller locations, and general routing of network cabling.

4. Review operating and maintenance of hardware devices including controllers, instruments, and sensors. Include schedule for routine maintenance.

5. Review operation of operator's workstation; include hardware.

6. Review operator's workstation software using specific examples of operating hardware.

7. Review portable operator's workstation software using specific examples of operating hardware.

C. Provide schedule of regularly scheduled factory classroom training classes concerning advanced topics covering proper operation and maintenance of all control systems, sensing,

monitoring and control equipment. All additional classes, travel and lodging to be arranged and paid by Owner.

D. Provide minimum of 8 hours of additional on-site training to Owner's Representatives, 6 months after initial training is completed.

E. Scheduling of training session(s) will be established by Owner.

APPENDIX A– Minimum Points - Display and programming requirements. Additional points are shown on the drawings and elsewhere in the specifications.

The following commands in addition to points shown on the drawings, displays and data shall be available at the operator's terminal, including, but not limited to:

A. Air Handling Unit:

.1. Fan start/stop

.2. Fan status

.3. Supply air temperature

.4. Return air temperature

.5. Return air humidity

.6. Mixed air temperature

.7. Outside air temperature

.8. Outside air humidity

.9. Supply air temperature reset

.10. Cooling/heating valve position (% of full open)

.11. The following points are only required if required by control strategy.

a. VFD drive status/speed

b. Damper positions (% of full open)

c. Duct static pressure

d. Fan speed (% of full speed)

e. Freeze protection status

f. Alarms (VFD, temperature, flow)

B. Chilled/Hot Water System:

1. Pumps start/stop
2. Pumps status
3. Automatic Lead/Lag control
4. Supply and return temperature
5. Supply temperature or Outside Air reset
6. High/low temperature alarms
7. Outside air temperature
8. Outside air humidity

C. Boiler System

1. Boiler start/stop
2. Boiler status
3. Hot water pumps start/stop
4. Hot water pumps status
5. Supply and return temperature
6. Automatic Lead/Lag control

D. Air Terminals:

1. Current space temperature
2. Occupied setpoint
3. Unoccupied setpoint
4. Current status
5. Supply air temperature
6. Minimum and Maximum air flow setting (CFM)
7. Current air flow reading (CFM)
8. Reheat valve position (% of full open)
9. High/low temperature alarm

E. Fan Coil Units:

1. Current space temperature
2. Occupied setpoint
3. Unoccupied setpoint
4. Current status
5. Supply air temperature
6. CW and HW valve position (% of full open)

F. Exhaust Fans:

1. Fan start/stop and status

END OF SECTION 230900

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.4 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.5 COORDINATION

A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: Use only 15% silver solder BcuP-5 with a non-corrosive flux.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Type ACR drawn-copper tubing.

3.2 PIPING INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Install piping to comply with recommendations of the manufacturer of the equipment.

C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

F. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 72 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2 and 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.

3.3 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP-5, 15% silver, copper-phosphorus alloy for joining copper socket fittings with copper pipe.

2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

B. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

3.4 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter-dryer after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

3.5 FIELD QUALITY CONTROL

A. Work must be conducted under supervision of an EPA certified technician.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   a. Test high- and low-pressure side piping of each system separately.

3.6 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

1. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch w.g.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

A. Product Data: For duct sealing materials.

B. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.5 QUALITY ASSURANCE

A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.

C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.

C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 DUCT LINER

A. Duct liner is only allowed where specifically called for by note on the design drawings where for critical acoustic purposes.

B. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville 2-inch thick Linacoustic RC flexible, or Linacoustic R300 Rigid duct liner, (for round duct Johns Manville Spriacoustic Plus), or comparable product by one of the following:

    a. CertainTeed Corporation; Insulation Group.
    b. Johns Manville.
    c. Knauf Insulation.
    d. Owens Corning.
    e. Maximum Thermal Conductivity:

        1) Type I, Flexible: 0.13 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
        2) Type II, Rigid: 0.12 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick **stainless steel**; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.3 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
   1. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with tape to form a hard, durable, airtight seal.
   2. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
   3. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.

B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.

   1. Hangers: Electrogalvanized or cadmium coated all-thread rod or galvanized rods with threads painted after installation.
   2. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

   1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
   2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
   3. Supports for Aluminum Ducts: Aluminum support materials, unless materials are electrolytically separated from ductwork.

2.5 RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals. Button punch snaplock construction is not acceptable.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:

1. Supply Ducts Upstream of terminals: 6-inch wg.
2. Supply Ducts Downstream of terminals: 2-inch wg
3. Return Ducts: 2-inch wg, negative pressure.
4. Exhaust Ducts: 2-inch wg, negative pressure.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

2.6 ROUND AND FLAT-OVAL DUCT FABRICATION

A. General: Diameter as applied to flat-oval ducts in this Article is the diameter of the size of round duct that has a circumference equal to perimeter of a given size of flat-oval duct.

B. Round Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval Ducts: Fabricate supply ducts with standard spiral lock seams or with butt-welded longitudinal seams according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

D. Double-Wall (Insulated) Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner liner. Dimensions indicated on internally insulated ducts are inside dimensions.

1. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
2. Outer Shell: Base outer-shell metal thickness on actual outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner shell and insulation, and in metal thickness specified for single-wall duct.
3. Insulation: 1-inch- thick fibrous-glass insulation, unless otherwise indicated. Terminate insulation where internally insulated duct connects to single-wall duct or uninsulated components. Terminate insulation and reduce outer duct diameter to inner liner diameter.
4. Solid Inner Liner: Fabricate round and flat-oval inner liners with solid sheet metal of thickness listed below:
5. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

2.7 ROUND AND FLAT-OVAL SUPPLY AND EXHAUST FITTING FABRICATION

A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.

B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.

C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

D. Double-Wall (Insulated) Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner liner. Dimensions indicated on internally insulated ducts are inside dimensions.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.

B. Construct and install each duct system for the specific duct pressure classification indicated.

C. Ducts will be delivered to the site with the interior completely clean and sealed to prevent migration of dust or moisture. Ducts shall remain sealed while in storage. Installed ductwork shall remain sealed at all times to prevent dust, debris and moisture contaminating duct interior. Refer to SMACNA standards.

D. Install round and flat-oval ducts in lengths not less than 12 feet, unless interrupted by fittings.

E. Install ducts with fewest possible joints.

F. Install fabricated fittings for changes in directions, changes in size and shape, and connections.

G. Install couplings tight to duct wall surface with a minimum of projections into duct.

H. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.

I. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

J. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

K. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.

L. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

M. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

N. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.

O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Firestopping."

3.2 SEAM AND JOINT SEALING

A. General: Seal all duct seams and joints to SMACNA Seal Class A regardless of duct pressure class. Reference SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Seal externally insulated ducts before insulation installation.

3.3 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

E. Install concrete inserts before placing concrete.

F. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3.4 CONNECTIONS

A. Connect equipment with flexible connectors according to Division 23 Section "Duct Accessories."

B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.5 FIELD QUALITY CONTROL

A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.

B. Conduct tests, in presence of Architect, at static pressures equal to maximum design pressure of system or section being tested. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Determine leakage from entire system or section of system by relating leakage to surface area of test section.

D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round and flat-oval ducts, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg.

E. Remake leaking joints and retest until leakage is less than maximum allowable.

F. Leakage Test: medium pressure ductwork shall be leak tested. Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

3.6 ADJUSTING

A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow.

3.7 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Turning vanes.
5. Duct-mounted access doors and panels.
6. Flexible ducts.
7. Flexible connectors.
8. Duct accessory hardware.
9. Louvers

1.3 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Duct-mounted access doors and panels.
5. Louvers and Louvered Penthouses
6. Flexible ducts.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:

1. Special fittings and manual- and automatic-volume-damper installations.
2. Fire- and smoke-damper installations, including sleeves and duct-mounted access doors and panels.

C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA standards:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

C. Aluminum Sheets: ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.

D. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches

2.2 BACKDRAFT DAMPERS

A. Description: Suitable for horizontal or vertical installations.

B. Frame: 0.052-inch- thick, galvanized, sheet steel, with welded corners and mounting flange.

C. Frame: 0.052-inch- thick, galvanized, sheet steel, with welded corners.

D. Frame: 0.063-inch- thick extruded aluminum, with mounting flange.

E. Frame: 0.063-inch- thick extruded aluminum.

F. Blades: 0.025-inch- thick, roll-formed aluminum.

G. Blades: 0.050-inch- thick aluminum sheet.

H. Blade Seals: Felt.

I. Blade Seals: Vinyl.

J. Blade Seals: Neoprene.

K. Blade Axles: Nonferrous.

L. Blade Axles: Galvanized steel.

M. Tie Bars and Brackets: Aluminum.

N. Tie Bars and Brackets: Galvanized steel.

O. Return Spring: Adjustable tension.

2.3 MANUAL-VOLUME DAMPERS

A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

2. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

3. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized, sheet steel.

4. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.

5. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Axles: Nonferrous.

7. Blade Axles: Galvanized steel.

8. Tie Bars and Brackets: Aluminum.

9. Tie Bars and Brackets: Galvanized steel.

D. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

2. Aluminum Frames: Hat-shaped, 0.063-inch- thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

3. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized, sheet steel.

4. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.

5. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Seals: Felt.

7. Blade Seals: Vinyl.

8. Blade Seals: Neoprene.

9. Blade Axles: Nonferrous.

10. Blade Axles: Galvanized steel.

11. Tie Bars and Brackets: Aluminum.

12. Tie Bars and Brackets: Galvanized steel.

E. High-Performance Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

2. Aluminum Frames: Hat-shaped, 0.125-inch- thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

3. Steel Blades: 0.052-inch-thick, galvanized, sheet steel; airfoil shaped.

4. Extruded-Aluminum Blades: Minimum of 0.081-inch- thick, 6063T extruded aluminum.

5. Blade Seals: Dual-durometer vinyl on blade edges; metallic compression on jambs.

6. Blade Axles: Nonferrous.

7. Blade Axles: Galvanized steel.

8. Tie Bars and Brackets: Aluminum.

9. Tie Bars and Brackets: Galvanized steel.

F. Jackshaft: 1-inch-diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.

G. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 CONTROL DAMPERS

A. Duct and plenum mounted dampers shall be low leakage type with blade and jamb seals designed to operate in systems having velocities up to 3,000 FPM with a static pressure differential of 4" WG. Leakage shall not exceed 6 CFM per square foot at 4" WG. The frame shall be minimum 16 gauge galvanized steel roll formed channel or aluminum hat channel. Blades shall be airfoil shaped aluminum with a maximum width of 6". Shafts shall be minimum 1/2" diameter. Maximum damper sections size shall be 60" x 72", with larger damper installed in sections with appropriate jack shafting. Damper linkage shall be concealed. Ruskin CD-50 or approved equal by Arrow, Air Balance or Cook.

B. All multiple blade duct mounted proportional control dampers shall be opposed blade type and all two-position dampers shall be parallel or opposed blade type.

2.5 FIRE DAMPERS

A. General: Labeled to UL 555.

B. Fire Rating: One and one-half and three hours.

C. Frame: SMACNA Type A with blades in airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

D. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.

1. Minimum Thickness: 0.052 inch or 0.138 inch thick as indicated, and length to suit application.

2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized steel blade connectors.

H. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.

I. Fusible Link: Replaceable, 165 or 212 deg F rated as indicated.

2.6 SMOKE DAMPERS

A. General: Labeled to UL 555S. Combination fire and smoke dampers shall be labeled for one-and-one-half-hour rating to UL 555.

B. Fusible Link: Replaceable, 165 or 212 deg F rated as indicated.

C. Frame and Blades: galvanized, sheet steel.

D. Mounting Sleeve: Factory-installed, galvanized, sheet steel; length to suit wall or floor application.

2.7 CEILING FIRE RADIATION DAMPERS

A. General: Labeled to UL 555C; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

B. Frame: 0.040-inch- thick, galvanized, sheet steel; round or rectangular; style to suit ceiling construction.

C. Blades: 0.034-inch- thick, galvanized, sheet steel with nonasbestos refractory insulation.

D. Volume Adjustment: UL-labeled, fusible volume-control adjustment.

E. Fusible Link: Replaceable, 165 deg F rated.

F. Fusible Link: Replaceable, 212 deg F rated.

G. Fusible Link: Replaceable, 285 deg F rated.

2.8 COMBINATION FIRE AND SMOKE DAMPERS

A. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

B. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

C. Fire Rating: 1-1/2 and 3 hours as indicated.

D. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded or interlocking, gusseted or mechanically attached corners and mounting flange.

E. Heat-Responsive Device: Replaceable, 165 deg F and 212 deg F rated, fusible links.

F. Smoke Detector: Integral, factory wired for single-point connection.

G. Blades: Roll-formed, horizontal, galvanized sheet steel.

H. Rated pressure and velocity to exceed design airflow conditions.

I. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application.

2.9 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch- wide, curved blades set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into side strips suitable for mounting in ducts.

C. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.10 LOUVERS

A. Louvers shall be anodized finish aluminum wind-driven rain resistant type. Louvers shall be 5" deep with aluminum bird screen on the exterior face of the louver

B. Material:
   1. Frame: Extruded Aluminum alloy 6063, .081" thick
   2. Blades .063” extruded aluminum
   3. Screen: 5/8” x .040” expanded flattened aluminum in removable frame.

C. Performance:
   1. .15” wg air pressure drop at 1000 fpm.
   2. Beginning point of water penetration at .01 oz/sf is above 1250 fpm
   3. Class A performance

D. Acceptable manufacturers include but are not limited to the following:
   1. Ruskin Co model EME520DD
   2. Airline Products Co
   3. Airolite Co

4. Industrial Louvers, Inc

E. Sill: Provide Sill Extensions.

F. Shape: As shown on the drawings.

G. Screen: Provide full-screen,(bird screen) unit on outside of louver

H. Finish: KYNAR fluorocarbon coating. Color: as selected by Architect

2.11 GRAVITY ROOF VENTILATORS

A. General: Gravity roof ventilators shall be constructed of heavy gauge aluminum with arched panels and interlocking seams. Base height shall be 12" and constructed with the curb cap 8" greater than the throat size. Provide aluminum bird screens on the hood overhang and aluminum insect screen tightly fitted to the top of the throat. Hoods shall be designed for intakes or relief as shown on the drawing. Intake hoods shall have a 2 to 1 intake hood to throat area ratio.

2.12 DUCT SILENCERS

A. General: Factory-fabricated and -tested, round or rectangular silencer with performance characteristics and physical requirements as indicated.

B. Fire Performance: Adhesives, sealers, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame spread and 50 for smoke developed when tested according to ASTM E 84.

C. Round and Rectangular Units: Fabricate casings with solid sheet metal for outer casing and perforated sheet metal for inner casing.

D. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

E. Fibrous Acoustic-Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.

F. Nonfibrous Acoustic-Fill Material: Moisture-proof nonfibrous material.

G. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.
1. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
2. Reinforcement: Cross or trapeze angles for rigid suspension.

H. Source Quality Control: Perform the following factory tests:

1. Acoustic Performance: Test according to ASTM E 477, with airflow in both directions through silencer.
2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels, for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with an airflow of at least 2000-fpm face velocity.
3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.13 DUCT-MOUNTED ACCESS DOORS AND PANELS

A. General: Fabricate doors and panels airtight and suitable for duct pressure class.

B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.

C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.14 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.

C. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.

D. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches mm) wide attached to two strips of 4-3/8-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.

E. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.

1. Minimum Weight: 26 oz./sq. yd..

2. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inchin the filling.

F. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.

1. Minimum Weight: 26 oz./sq. yd.

2. Tensile Strength: 530 lbf/inch in the warp, and 440 lbf/inch in the filling.

G. High-Temperature System Flexible Connectors: Glass fabric coated with silicone rubber and having a minimum weight of 16 oz./sq. yd. and tensile strength of 285 lbf/inch in the warp, and 185 lbf/inch in the filling.

H. High-Corrosive-Environment System Flexible Connectors: Glass fabric coated with a chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd.

2. Tensile Strength: 450 lbf/inch in the warp, and 340 lbf/inch in the filling.

2.15 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1.

B. Flexible Ducts, Uninsulated: Spiral-wound steel spring with flameproof vinyl sheathing.

C. Flexible Ducts, Uninsulated: Corrugated aluminum.

D. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch-thick, glass-fiber insulation around a continuous inner liner.

1. Reinforcement: Steel-wire helix encapsulated in inner liner.

2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.

3. Outer Jacket: Polyethylene film.

4. Inner Liner: Polyethylene film.

E. Pressure Rating: 6-inch wg positive, 1/2-inch wg negative.

2.16 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 length to suit duct insulation thickness.

B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.

D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.

B. Internal duct lining shall not be used, except for specifically indicated on drawings.

C. Provide test holes at fan inlet and outlet and elsewhere as indicated.

D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.

1. Install fusible links in fire dampers.

E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.

1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.

2. Install access panels on side of duct where adequate clearance is available.

F. Label access doors according to Division 23 Section "Mechanical Identification."

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Centrifugal roof ventilators.
2. Centrifugal wall ventilators.
3. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS – GENERAL PURPOSE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Greenheck or a comparable product by one of the following:

1. Loren Cook Company.
2. Penn-Barry.
3. Twin City.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches.
3. Sound Curb: Curb with sound-absorbing insulation matrix.

4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Mounting Pedestal: Galvanized steel with removable access panel.
7. Vented Curb: Unlined with louvered vents in vertical sides.

2.2 IN-LINE AND MIXED-FLOW CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Greenheck or a comparable product by one of the following:

1. Loren Cook Company.
2. Penn-Barry.
3. Twin City.

B. Description: In-line, direct or belt-driven (as scheduled on drawings) centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.3 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

C. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Pressure independent, shutoff, single-duct air terminals.
2. Pressure independent, single-duct air terminals with electric reheat.
3. Pressure independent, fan-powered air terminals with electric reheat.

B. DDC controllers shall be provided by the control vendor and installed by the VAV terminal manufacturer at the factory.

C. Terminal manufacturer shall include the installation of the DDC controllers, actuator and internal wiring by the factory via a transformer as required to provide a complete installation. Actuators shall be compatible with DDC controller and supplied by the Control Vendor.

1.3 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated. Include a schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.

B. Maintenance Data: List of parts for each type of air terminal and troubleshooting maintenance guide to include in the maintenance manuals. In addition, provide instruction for resetting minimum and maximum air volumes and adjusting software set points.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Comply with NFPA 70 for electrical components and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide air terminals by one of the following:

1. JCI
2. Nailor
3. Price
4. Trane

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINALS

A. Configuration: Volume-damper assembly inside unit casing. Locate control components inside protective metal shroud.

B. Casings: 22 gauge galvanized steel with round or flat oval inlets. Casing leakage downstream of the damper shall not exceed 1% at 1" wg. High side casing leakage shall not exceed 2% at 3" wg.

C. Casing Lining: Minimum of ¾" thick fiber free closed cell elastomeric foam liner complying with NFPA 90A requirements and UL 181 (25/50 smoke and flame spread).

D. Damper: Primary air valve shall be constructed of heavy gauge metal with peripheral gasket and solid steel shaft, pivoted in self-lubricating bearings. Air leakage past the closed damper shall not exceed 2% at 3" wg.

E. Air flow sensor: The air flow sensor shall be of a cross configuration. Sensor shall provide accuracy within 5% with a 90° elbow directly at the inlet of the assembly.

F. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. SCR controlled.
2. Access door interlocked disconnect switch.
3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
4. Nickel chrome 80/20 heating elements.
5. Airflow switch for proof of airflow.
6. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
7. Mercury contactors.
8. Pneumatic-electric switches and relays.

G. Pressure differential reset controller shall maintain set point (CFM) within 5%, regardless of system pressure change. CFM limiting devices are not acceptable. The reset controller shall constantly monitor thermostat input, air flow (CFM), and system static and total pressures in a manner as to minimize under - or over - controlling in relation to the space temperature requirements. The reset controller shall be capable of field adjustment of minimum and maximum CFM settings without the use of tools. Flow curve for field balancing shall be affixed to terminal casting. Differential flow taps and factory-set CFM shall be provided if so noted at terminal schedule on the drawings. Controller shall maintain pressure independence to as low as .03" w.g.

H. Terminals shall operate as variable/constant volume terminals. Terminals shall be provided with adjustable maximum and minimum CFM settings.

2.3 PARALLEL FAN-POWERED AIR TERMINAL UNITS

A. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside protective metal shroud. Designed for quiet operation. Fan terminals shall contain all of the features of variable volume terminals and shall also contain a, ECM motor directly driving a forward curved fan section. Fan operation shall be first stage of heating. All units shall contain filter frame with disposable media and unit mounted disconnect switch. Heating CFM shall be the same as cooling CFM.

B. Casings: 22 gauge galvanized steel with round or flat oval inlets. Casing leakage downstream of the damper shall not exceed 1% at 1" wg. High side casing leakage shall not exceed 2% at 3" wg.

1. Casing Lining: Minimum of ¾" thick fiber-free, closed cell elastomeric foam liner complying with NFPA 90A requirement and YL 181 (25/50 smoke and flame spread).
2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
5. Fan: Forward-curved centrifugal, located at plenum air inlet.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
2. Damper Position: Normally closed.

D. Velocity Sensors: Multipoint array with velocity sensors.

E. Motor:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Type: Electronically commutated motor.
3. Fan-Motor Assembly Isolation: Rubber isolators.

F. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Material: Pleated cotton-polyester media having 90 percent arrestance and 7 MERV.
2. Thickness: 1-inch.

G. Attenuator Section: 0.034-inch galvanized steel sheet.

1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for flexible elastomeric duct liner.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Location: Plenum air inlet.
2. SCR controlled.
3. Access door interlocked disconnect switch.
4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
5. Nickel chrome 80/20 heating elements.
6. Airflow switch for proof of airflow.
7. Fan interlock contacts.
8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
9. Mercury contactors.
10. Pneumatic-electric switches and relays.
11. Magnetic contactor for each step of control (for three-phase coils).

I. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.

1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
3. Disconnect Switch: Factory-mounted, fuse type.

J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

K. Control devices shall be compatible with temperature controls system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

1. Electric Damper Actuator: 24 V, powered open, spring or capacitous return.
2. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg; and shall have a multipoint velocity sensor at air inlet.
3. Terminal Unit Controller: Pressure-independent, VAV controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.2 INSTALLATION

A. Install air terminals level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards; and maintain sufficient clearance for normal service and maintenance.

B. Connect ductwork to air terminals according to Division 23 ductwork Sections.

C. All terminals units shall include acoustic discharge silencers where shown on drawings plans.

3.3 CONNECTIONS

A. Install piping adjacent to air terminals to allow service and maintenance.

B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Electrical: Comply with applicable requirements in Division 26 Sections.

3.4 FIELD QUALITY CONTROL

A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.6 COMMISSIONING

A. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.

B. Check that controls and control enclosure are accessible.

C. Check that nameplate and identification tag are visible.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

A. Product Data: For each model indicated, include the following:

1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

1.5 QUALITY ASSURANCE

A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Diffusers, registers, and grilles are scheduled on Drawings.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Metalaire
b. Nailor Industries Inc
c. Price
d. Titus.

2.2 SOURCE QUALITY CONTROL

A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 234100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.3 SUBMITTALS

A. Product Data: Include dimensions; shipping, installed, and operating weights; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.

1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.

C. Maintenance Data: For each type of filter and rack to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A and NFPA 90B.

B. ASHRAE Compliance: Comply with provisions of ASHRAE 52.2 for method of testing and rating air-filter units.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide two (2) complete sets of filters for each filter bank.

PART 2 - PRODUCTS

2.1 DISPOSABLE PANEL FILTERS

A. Description: Factory-fabricated, viscous-coated, pleated type, disposable air filters with holding frames.

B. Efficiency: 25% to 30% with a MERV 6-7.

C. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

D. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

E. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

E. Prefilters: Provide 2” pleated, 30% efficient replacement media prefilters mounted on the face of 2 each high efficiency cartridge and held in place by a hinged gate which is an integral part of the holding frame.

2.2 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS

A. Description: Factory-fabricated, dry, extended-surface filters with holding frames. Filters shall be supported by wire grid to prevent sagging.

B. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.

C. Media and Media-Grid Frame: Galvanized steel.

D. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

E. 85% Efficiency with a MERV 13 Filters: Each 24 x 24 filter unit shall be rated for 2000 CFM. Initial pressure drop shall be .35" WG. Final pressure drop shall be 1.0" WG. Unit shall consist of high density microfine glass fiber filter media held rigidly in an enclosing frame by a welded wire support grid. Wire grid shall have an effective open area of not less than 96%. Media shall be arranged in pleats so that no less than 14.5 square feet of media is exposed in 1 square foot of unit face area. Media shall be bonded to enclosing frame to prevent air bypass.

2.3 FRONT- AND REAR-ACCESS FILTER FRAMES

A. Framing System: Aluminum framing members with access for either upstream (front) or downstream (rear) filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters prevent deflection of horizontal members without interfering with either filter installation or operation.

B. Prefilters: Incorporate a separate track, removable from front or back.

C. Sealing: Factory-installed, positive-sealing device for each row of filters to ensure seal between gasketed filter elements to prevent bypass of unfiltered air.

2.4 SIDE-SERVICE HOUSINGS

A. Description: Factory-assembled, side-service housings, constructed of galvanized steel, with flanges to connect to duct system.

B. Prefilters: Integral tracks to accommodate 2-inch disposable filters.

C. Access Doors: Continuous gaskets on perimeter and positive-locking devices. Arrange so filter cartridges can be loaded from either access door.

D. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

2.5 FILTER GAGES

A. Description: Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.

1. Diameter: 4-1/2 inches.

B. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install filter frames according to manufacturer's written instructions.

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air.

D. Install filter gage for each filter bank.

E. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position.

3.2 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234100

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS – RELIEF AIR CONFIGUATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes high-efficiency, packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Direct-expansion cooling.
2. Hot-gas Reheat
3. Electric-heating coils
4. Variable speed drives
5. Economizer outdoor- and return-air damper section.
6. Integral, space temperature controls.
7. Roof curbs.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units.

C. Supply-Air Fan: The fan providing supply-air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

D. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Performance:

1. Basic Wind Speed: Per North Carolina Building Code.

B. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to North Carolina Building code.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.
2. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2013, Section 5 - "Systems and Equipment."

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. AHRI CERTIFICATION

1. Comply with AHRI Standard 340/360.

C. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigerant system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1-2013, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1-2010 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2013, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

F. UL Compliance: Comply with UL 1995.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.
3. Warranty Period for all Parts and Components not listed above: Manufacturer’s standard, but not less than one year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trane (Basis of Design)
2. Carrier Corporation.
3. Daikin
4. JCI York

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: G90 galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

1. Exterior Casing Thickness: Minimum 16 gauge thick minimum.

C. Inner Casing Fabrication Requirements:

1. Inside Casing: G90 galvanized steel, 20 gauge thick minimum, solid liner.

D. Total Static Pressure: Unit shall be designed to operate at pressures of up to 6.5 inches of total static pressure.

E. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.

2. Thickness: 1 inch minimum with R-value 6.5.
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
4. Liner Adhesive: Comply with ASTM C 916, Type I.

F. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1-2013.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple both sides of drain pan.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2013.

2.3 FANS

A. Direct-Driven Supply-Air Fans: Double width, forward curved or backward inclined, centrifugal; with permanently lubricated, motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

C. Condenser-Coil Fan: Propeller, low-sound mounted on shaft of permanently lubricated motor.

D. Relief-Air Fan: Direct- or Belt-driven Forward curved or backward inclined, shaft mounted on permanently lubricated motor.

E. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

F. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

A. Supply-Air Refrigerant Coil:

1. Aluminum or copper plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
3. Coil Split: Coils shall be multi-row, staggered tube designed with minimum of 6 rows for maximum dehumidification. All units shall have minimum two independent refrigerant circuits and use an interlaced coil circuiting that keeps the full coil face active at all load conditions.
4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1-2013.

B. Outdoor-Air Refrigerant Coil:

1. Aluminum- or copper-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

C. Hot-Gas Reheat Refrigeration Coil:

1. Aluminum- or copper-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

D. Electric-Resistance Heating:

1. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
2. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
3. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
4. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:

    a. Solid State Magnetic contactors.
    b. Step Controller: Pilot lights and override toggle switch for each step.
    c. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
    d. Time-delay relay.
    e. Airflow proving switch.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigeration Circuits: Two.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

C. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator (where applicable).

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated: Minimum 2-inch thick MERV 8 Pre-filters and 6” MERV 13 Final Filters.

2.7 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1-2013, with bird screen and hood.

2.8 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted non-fused disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

B. Provide phase and voltage monitor to protect 3-phase equipment from phase loss, phase reversal, and low voltage. Any fault condition shall send the unit into and emergency stop condition.

C. Provide minimum Short Circuit Current Rating (SCCR) equipment rating of 65,000 Amperes for 480 volt equipment (22,000 Amperes for 208 volt equipment).

D. Provide motors with internal shaft grounding rings to be used with VFDs to provide conductive discharge path away from the motor bearing to ground.

2.9 CONTROLS

A. Basic Unit Controls:

1. Control-voltage transformer.

B. DDC Controller:

1. Controller shall have volatile-memory backup.
2. Interface with building BAS utilizing BACnet protocol.
3. Safety Control Operation:

    a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.

    b. Fire Alarm Control Panel Interface: Provide control interface to coordinate with building Fire Alarm System.

    c. Low-Discharge Temperature: Stop fans and close outdoor-air dampers if supply air temperature is less than 40°F.

4. Supply Fan Operation:

    a. Occupied Periods: Run fan continuously.
    b. Unoccupied Periods: Cycle fan to maintain setback temperature.

5. Refrigerant Circuit Operation:

    a. Occupied Periods: Cycle or stage compressors to match compressor output to cooling load to maintain [room] [discharge] temperature. Cycle condenser fans to maintain maximum hot-gas pressure.
    b. Unoccupied Periods: Compressors off.

6. Hot-Gas Reheat-Coil Operation:

    a. Occupied Periods: Humidistat opens hot-gas valve to provide hot-gas reheat, and cycles, or varies the speed, of the compressors.
    b. Unoccupied Periods: Reheat not required.

7. Electric-Heating-Coil Operation:

a. Occupied Periods: Stage or Modulate coil to maintain discharge temperature.
b. Unoccupied Periods: Energize coil to maintain setback temperature.

8. Economizer Outdoor-Air Damper Operation:

a. Occupied Periods: Open to fixed minimum intake indicated on drawings, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 55 °F. Use mixed-air temperature and select between outdoor-air and return-air enthalpy to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
c. Outdoor Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature.

d. Occupied Periods: Reset minimum outdoor-air ratio down to minimum 10 percent to maintain maximum 1000-ppm concentration.
e. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

9. Building pressure control utilizing space pressure sensor, relief dampers and relief air fan(s).

C. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:

a. Adjusting set points.
b. Monitoring supply and relief fan start-stop-status.
c. Monitoring Alarms.
d. Supply Air Temperature
e. Monitoring supply fan start, stop, and operation.
f. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
g. Monitoring occupied and unoccupied operations.
h. Monitoring constant and variable motor loads.
i. Monitoring variable frequency drives.
j. Monitoring economizer cycles.
k. Monitoring air distribution static pressure and ventilation volume.

2.10 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

C. Hail guards of galvanized steel, painted to match casing.

2.11 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints.

1. Curbs shall contain spring isolators for vibration elimination.

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C 1071, Type I or II.
b. Thickness: Not less than1-1/2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.

C. Curb Height: Minimum 14 inches, or as required for code required height above the roof (also see drawings). Provide curb that compensates for roof slope. Install unit level. The contractor is responsible for confirming roof insulation thickness and slope and providing curb of adequate height.

D. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

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

3.2 INSTALLATION

A. Demolition:

1. Remove existing RTU and any previously installed curb adaptor. Disconnect electrical and control connections.
2. Properly capture and properly dispose of refrigerant and oils.

B. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

C. Roof Curb: Install RTUs on roof structure, level and secure, according to AHRI Guideline B. Install RTU's on curbs and coordinate roof penetrations and flashings with roof construction specified in Project Manual. Secure RTU's to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Curbs shall be sloped for level installation on roof. Install units

D. Install wind and seismic restraints according to manufacturer's written instructions. Verify condensate drainage requirements of authorities having jurisdiction.

E. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain. Drain pipe material shall be Schedule 40 PVC with solvent joints.

B. Install piping adjacent to RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements,

1. Extend or otherwise modify ducts to termination at top of roof curb.
2. Remove decking only as required for passage of ducts. Do not cut decking under entire roof curb.
3. Connect supply ducts to RTU's with flexible duct connectors.
4. Extend return-air duct continuously through roof structure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Clean condenser coil and inspect for construction debris.
9. Inspect operation of barometric relief dampers.
10. Verify lubrication on fan and motor bearings.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Adjust fan belts to proper alignment and tension.
13. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

14. Inspect and record performance of interlocks and protective devices; verify sequences.
15. Operate unit for an initial period as recommended or required by manufacturer.
16. Calibrate thermostats.
17. Adjust and inspect high-temperature limits.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

20. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

22. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

23. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

B. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237413

SECTION 238127 - DUCTLESS SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes ductless split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting.

1.3 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Maintenance Data: For split-system air-conditioning units to include in maintenance manuals.

C. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC.

D. Units shall be constructed in accordance with UL standards.

E. Unit cabinet shall be capable of withstanding Federal Test Standard No. 141 (Method 6061) 500-Hour Salt Spray Test.

F. Air-cooled condenser coils shall be leak-tested at 350 psig air pressure

1.5 COORDINATION

A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases.

B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

C. Warranty Period: five (5) years from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mitsubishi Electronics America, Inc.; HVAC Division.
2. Daikin
3. Sanyo HVAC.
4. LG

2.2 EVAPORATOR-FAN CABINET COMPONENTS

A. Cabinet: Cabinet discharge and inlet grilles shall be high-impact polystyrene or sheet metal. Cabinet shall be fully insulated for improved thermal and acoustic performance

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

D. Fan and Motor: Centrifugal fan, directly driven by multispeed, electric motor with integral overload protection; resiliently mounted.

E. Filters: Permanent cleanable.

F. Condensate Pump: A condensate pump shall be provided to remove condensate from the drain pan when gravity drainage cannot be used. Pump shall consist of two parts: an internal reservoir/sensor assembly, and a remote sound-shielded pump assembly. The lift capability of the condensate pump shall be 1 to 20 ft. A level sensor on the condensate pan shall stop cooling operation if the level in the condensate pan is unacceptable

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.

E. Fan: Aluminum-propeller type, directly connected to motor.

F. Motor: Permanently lubricated, with integral thermal-overload protection.

G. Low Ambient Kit: Permits operation down to 0 deg F.

2.4 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Automatic restart after power failure.

D. Low ambient to 0°F.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounted, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit.

D. Install roof-mounted compressor-condenser components on equipment supports. Anchor units to supports with removable, cadmium-plated fasteners.

E. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Install piping adjacent to unit to allow service and maintenance.

B. Ground equipment.

3.3 FIELD QUALITY CONTROL

A. Installation Inspection: Inspect field-assembled components and equipment installation, including piping and electrical connections, and to prepare a written report of inspection.

B. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 COMMISSIONING

A. Perform startup checks according to manufacturer's written instructions and do the following:

1. Fill out manufacturer's checklists.
2. Check for unobstructed airflow over coils.
3. Check operation of condenser capacity-control device.
4. Verify that vibration isolation devices and flexible connectors dampen vibration transmission to structure.

3.5 DEMONSTRATION

Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238127

DIVISION 26

ELECTRICAL

SECTION 260500 -COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Sleeves for raceways and cables.
   2. Supporting devices for electrical components.
   3. Electrical identification.
   4. Cutting and patching for electrical construction.
   5. Sleeve seals.
   6. Grout.
   7. Common electrical installation requirements.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. LFMC: Liquidtight flexible metal conduit.

D. RNC: Rigid nonmetallic conduit.

E. RMC Rigid metal conduit

F. AHJ: Authority Having Jurisdiction

1.4 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. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

1.5 INSPECTIONS

A. It is the responsibility of the electrical contractor to notify the engineer and local electrical inspections department to schedule all required inspections including rough-in, above ceiling and final inspections.

1.6 SUBMITTALS

A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.

B. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

C. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

1.7 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

B. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

D. Coordinate electrical service connections to components furnished by utility companies.

E. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.

F. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

G. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

H. Check, verify and coordinate work with other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with the building structure or other trades.

I. Drawings and specifications are necessarily schematic in nature and cannot describe completely all situations that might be encountered in the field. It is the responsibility of the contractor to familiarize himself with the scope of work required and include all work indicated or reasonably implied by the contract documents.

J. Work not covered in the Contract Documents will be required if it is reasonably inferable as being necessary to produce the results intended by the Contract documents for a completed

project to the level of quality consistent with the nature and standard of such work shown by the Drawings and Specifications.

K. Layout the work to prevent conflict with, and to coordinate with work of other trades. Systems shall generally be run in a rectilinear fashion.

L. Each trade is responsible for the coordination of their work with all other work at the site prior to beginning in each area.

M. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

N. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

O. After owner occupancy of premises, coordinate access to site directly with owner for correction of defective work and work not in accordance with the contract documents, to minimize disruption of owner activities. Contractors will be back charged for any additional security that is necessary to complete the work.

1.8 DIVISION OF WORK (Division 23/26)

A. This section delineates the division of work between Division 23 and Division 26.

B. Specific work to be done under Division 26 is hereinafter listed or described. All other work necessary for the operation of Division 23 equipment shall be performed under Division 23.

C. All individual motor starters for mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Division 23 unless indicated as a part of a motor control center. Motor starters for mechanical equipment provided in motor control centers shall be furnished under Division 26.

D. Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter or disconnect switch. Under Division 26, line side terminations shall be provided. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Division 23.

E. Duct smoke detectors shall be furnished and wired by Division 26, installed by Division 23. Fire alarm AHU shut down circuits shall be wired from the fire alarm control panel to a termination point, adjacent to the AHU control, under Division 26. AHU control wiring from the termination point to the equipment shall be under Division 23.

F. All relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote pushbutton stations, emergency

break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 23 shall be furnished, installed and wired under Division 23 unless otherwise noted on plans.

G. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 23.

H. Roof exhaust fans with built-in disconnects provided under Division 23 shall be wired under Division 26 to the line side of the disconnect switch. A disconnect switch shall be provided under Division 26 if the fan is not provided with a built-in disconnect switch. In this case wiring from the switch to the fan shall be under Division 23.

I. The sequence of control for all equipment shall be as indicated on the Division 23 Drawings and specified in Section, HVAC Control System.

J. All sprinkler flow and tamper switches shall be furnished and installed under Division 15, and wired under Division 26.

K. Where electrical wiring is required by trades other than covered by Division 26, specifications for that section shall refer to same wiring materials and methods as specified under Division 26. No Exceptions.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Expansion Anchors: Carbon-steel wedge or sleeve type.

F. Toggle Bolts: All-steel springhead type.

2.2 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.3 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

G. Raceways Exposed to Different Temperatures.
   1. Sealing. Where portions of a cable raceway or sleeve are known to be subjected to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway or sleeve shall be filled with an approved material to prevent the circulation of warm air to a colder section of the raceway or sleeve.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

G. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

J. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

K. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
6. Steel: Welded threaded studs or spring-tension clamps on steel.

    a. Field Welding: Comply with AWS D1.1.

7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
8. Light Steel: Sheet-metal screws.
9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 6 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

3.5 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.6 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.7 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.8 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

3.9 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.3 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. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

PART 2 - PRODUCTS

2.1 BUILDING WIRES AND CABLES

A. UL-listed building wires and cables shall be 600 V, unless otherwise noted, color code conductors for low voltage (secondary feeders and branch circuits) as required by code.

B. Insulation for all interior conductors shall be dual rated THHN/THWN, or XHHW single conductor.

C. Conductor Material: Copper.

D. Stranding: Solid conductor for No. 10 AWG and smaller; Class B stranded conductor for No. 8 AWG and larger.

E. Power and lighting circuits minimum conductor size allowed is No. 12 AWG.

F. Largest conductor size allowed is 500 Kcmil unless otherwise noted on plans.

G. Control wiring shall have stranded conductors.

H. Lighting fixture whips shall be THHN/THWN conductors in flexible metal conduit, ½" minimum trade size.

I. Provide a dedicated neutral conductor with each branch circuit. No shared neutrals allowed.

J. Conductors shall be color coded as detailed in Section 260553, Identification for Electrical Systems.

2.2 CONNECTORS AND SPLICES

A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."

B. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

C. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. No more than one of each phase conductor A, B and C with the associated neutral(s) and ground conductor(s) shall be pulled in any common raceway.

E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

F. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

G. Seal around cables penetrating fire-rated elements.

H. Identify wires and cables according to Division 26 Section "Basic Electrical Materials and Methods."

I. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.

3.3 VOLTAGE DROP

A. Where the conductor length from the panel to the first outlet on a 277 volt system exceeds 125 feet, the minimum branch circuit conductor size shall not be smaller than No. 10 AWG.

B. Where the conductor length from the panel to the first outlet on a 120 volt system exceeds 50 feet, the minimum branch circuit conductor size shall not be smaller than No. 10 AWG

C. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

3.4 CONNECTIONS

A. Conductor Splices: Keep to minimum. All conductors shall be continuous from outlet to outlet. No splices shall be made except within junction boxes, troughs and gutters.

B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

C. Use splice and tap connectors compatible with conductor material.

D. Joints in solid conductors shall be spliced using ”Ideal” wirenuts, 3M Company “Scotchlock” or T&B “Piggy” fasteners.

E. Joints in stranded conductors shall be spliced by approved mechanical connectors and gum rubber tape or friction tape. Solderless mechanical connectors for splices and taps, provided with UL approved insulating covers may be used instead of mechanical connectors plus tape.

F. Sta-kon or other permanent type crimped connectors shall not be used for branch circuit connections.

3.5 FIELD QUALITY CONTROL

A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Grounding arrangements and connections for separately derived systems.
4. Grounding for sensitive electronic equipment.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at test wells and grounding connections for separately derived systems based on NETA MTS and NFPA 70B.

a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

D. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."

B. Equipment Grounding Conductors: Insulated with green-colored insulation.

C. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with insulators.

E. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

2.2 CONNECTOR PRODUCTS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel 3/4 inch by10 feet (19 mm by 3 m) in diameter. Minimum of three driven ground rods.

B. Building Steel

C. All metallic cold water pipes entering the building including those for domestic cold water and fire sprinkler service.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits. No circuit shall be without an equipment grounding conductor. The conduit shall not serve as the equipment grounding conductor.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus unless otherwise noted on drawings.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. All 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 including but not limited to domestic cold water and fire sprinkler service pipe. 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 conduit 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.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

B. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Report measured ground resistances that exceed the following values:
    1. 25 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring and other building systems.

1. Raceways include the following:

a. EMT: Electrical metallic tubing.
b. FMC: Flexible metal conduit.
c. LFMC: Liquidtight flexible metal conduit.
d. LFNC: Liquidtight flexible nonmetallic conduit.
e. RMC: Galvanized Rigid steel conduit.
f. RNC: Rigid nonmetallic conduit.
g. Wireways

2. Boxes, enclosures, and cabinets include the following:

a. Device boxes.
b. Floor boxes.
c. Outlet boxes.
d. Pull and junction boxes.
e. Cabinets and hinged-cover enclosures.

1.2 SUBMITTALS

A. Product Data: For wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.3 QUALITY ASSURANCE

A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.

B. Comply with NECA's "Standard of Installation."

C. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

1.4 COORDINATION

A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Galvanized Rigid Steel Conduit: ANSI C80.1.

B. EMT and Fittings: ANSI C80.3. with plated steel hexagonal compression type fittings with insulated throats. Fittings installed in concrete or masonry shall be “concrete tight”. Fittings installed in damp locations shall be “rain tight”.

C. FMC: Zinc-coated steel.

D. LFMC: Liquidtight Flexible steel conduit with PVC jacket.

E. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.2 NONMETALLIC CONDUIT AND TUBING

A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.

B. RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

C. LFNC: UL 1660.

2.3 METAL WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged type.

D. Finish: Manufacturer's standard enamel finish.

2.4 OUTLET AND DEVICE BOXES

A. Sheet Metal Boxes: NEMA OS 1.

B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.

2.5 FLOOR BOXES

A. Floor Boxes: Cast metal, fully adjustable, rectangular with brass cover.

2.6 PULL AND JUNCTION BOXES

A. Small Sheet Metal Boxes: NEMA OS 1.

B. Cast-Metal Boxes: NEMA FB 1, with gasketed cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

A. Outdoors: Use the following wiring methods:

1. Galvanized Rigid Steel.
2. Underground, RNC.
3. Connection to Vibrating Equipment LFMC.
4. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.

B. Indoors: Use the following wiring methods:

1. Exposed: Below 8 feet above the floor: Galvanized Rigid Steel.
2. Exposed: Above 8 feet above the floor: EMT with compression fittings.
3. Concealed: EMT with compression fittings.
4. Connection to Vibrating Equipment: FMC; except in wet or damp locations, use LFMC.
5. Damp or Wet Locations: Galvanized Rigid Steel conduit.
6. Lighting fixture whips: FMC
7. Boxes and Enclosures: NEMA 250, Type 1.
8. MC cable: Where concealed and not subject to physical abuse. May only be used for branch wiring to receptacles and other 120 volt devices. The primary homerun circuit from the panelboard to a junction box in the room containing the devices shall be in EMT. MC cable only may be used for the branch wiring from the junction box to the device. Branch circuits for kitchen equipment circuits shall be in conduit complete.

3.3 INSTALLATION

A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.

B. Minimum Raceway Size: 3/4-inch trade size, except 1” minimum for telecom/data outlets.

C. In finished areas of the Building, conceal conduit unless otherwise indicated, within finished walls, ceilings, and floors.

D. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

E. Install raceways level and square and at proper elevations. Provide adequate headroom.

F. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.

G. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

H. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.

I. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

J. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.

K. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semi recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.

3.4 UNDERGROUND RACEWAYS

A. Underground Raceways run external to building foundation walls, with the exception of branch circuit raceways, shall be encased with a minimum of three (3) inches of concrete on all sides.

B. Encased raceways must have a minimum cover of eighteen (18) inches, except for raceways containing circuits with voltages above 600 volts, which must have a minimum cover of thirty (30) inches.

C. All underground raceways shall be identified by underground line marking tape located directly above the raceway at 6 to 8 inches below finished grade. Tape shall be permanent, bright-colored, continuous printed, plastic tape compounded for direct burial not less than 6 inches wide and 4 mils thick. Printed legend shall be indicative of general type of underground line below.

D. Where underground raceways are required to turn up into cabinets, equipment, etc., and on to poles, the elbow required and the stub-up out of the slab or earth shall be of rigid steel.

E. The raceway system shall not be relied on for grounding continuity.

3.5 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.6 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260533

SECTION 260534 – TELEPHONE AND DATA COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes a raceway system for telephone, data communications. It also includes set of the IT Room for use by owner's IT vendor to install equipment. It Room set-up includes flame retardant plywood on walls, 2-post equipment racks, cable management, power, grounding, etc.

B. Telephone and data cabling, patch panels and all electronic equipment shall be provided and installed by the Owner's IT vendor. Electrical contractor shall coordinate with this vendor as required to install raceways and equipment power.

1.2 QUALITY ASSURANCE

A. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

1.3 RELATED SECTIONS:

A. Section 260500 - General Electrical

B. Section 260533 – Raceways and Boxes

C. Section 262726 - Wiring Devices

D. Section 260553 - Electrical Identification

1.4 REFERENCES

A. TIAIEIA 569 (Telecommunications Industries Association/Electronic Industries Association) - Commercial Building Standard for Telecommunications Pathways and Spaces.

B. TIA/EIA 607 - Commercial Building Grounding/Bonding Requirements.

C. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. BISCI - Building Industries Consulting Services International.

E. BISCI TDMM - Telecommunications Distribution Methods Manual.

F. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A

G. Grounding: Comply with ANSI-J-STD-607-A.

1.6 SUBMITTALS

A. Submit the following:

1) Product data for cable management systems, equipment racks and all equipment. Submit manufacturer, model number and technical data for each component.

PART 2 - PRODUCTS

2.1 RACEWAYS AND OUTLETS

A. Comply with Section 260533, Raceways and Boxes

B. 1" EMT conduit w/pull string for each outlet.

C. Conduit for wall mounted outlets shall run up 6" above ceiling and turns out to above the nearest accessible ceiling w/ 90-degree bend and bushing at end.

D. Provide 2" conduit sleeves from IT room cable rack to each Tenant Space. See plans for additional requirements.

2.2 CABLE TRAY SYSTEM

A. Low voltage, telecommunications use only.

B. 12” aluminum or steel ladder type cable rack with 9” rung spacing with all components required for complete pathway. Components include straight sections, elbows, tees, crosses, wyes, reducers, couplings, splice plates and supports as shown on drawings. The wire way shall be generally mounted from the IT conduit to above the equipment racks.

C. System shall be grounded: #6 AWG bonding conductor from cable tray to IT room grounding bus. Each section shall be bonded together.

2.3 EQUIPMENT RACKS

A. CPI Model #46353-703, Two post, freestanding, floor mounted, modular-aluminum, black, designed for telecommunications terminal support and coordinated with dimensions of units to be supported. All racks shall be grounded to the telecommunications ground bar.

B. Approximate Module Dimensions: 84 inches high with 19 inch rack mounting space.

C. Finish: Black, Baked-polyester powder coat.

D. Power Strip: Install an EIA 19 inch rack mounted strip of the base of the rack. Power strip shall be rated for 20 amps.

2.4 Cable management:

A. Front of the rack: Provide horizontal cable management (Panduit #WMP1E) in the very top position of the rack and then position another device between each patch panel. Provide vertical

management device with doors (Panduit #PR2VD06) on rack. Provide double vertical management between racks.

B. Rear of the rack: Provide horizontal cable management device between every two patch panels. Provide vertical cable management device on both sides of the rack.

C. Enclosed cable management shall be non-metallic.

2.5 EQUIPMENT ROOM

A. Provide 3/4" x 8' tall, fire retardant, plywood panels as shown on plans.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pulling means in all raceways.

B. All conduit shall be concealed in finished areas of the building.

3.2 Communications Closet

A. Plywood shall be at a minimum of 12" above finished floor. Anchors for plywood shall be sufficient to support all background equipment apparatus weighing up to 15 pounds per square foot of plywood space. Coordinate electrical outlets with the plywood panels.

B. Provide a telecommunications type ground bar with a #4AWG ground wire bonded to the service entrance ground.

3.3 Floor Distribution System

A. Conduit: A 1" conduit from each telecommunications outlet shall be extended complete to above nearest accessible ceiling or to IT Closet.

B. If more than two 90-degree bends or a linear distance exceeding 100 feet are required, a pull box must be installed and the locations of pull boxes shall be shown as installed in the record drawings.

C. The uses of LB, LL and LR fittings is not allowed.

D. Grounding: All vertical and horizontal metallic distribution systems must be grounded in accordance with National Electric Code.

END OF SECTION 260534

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

C. Comply with ANSI A13.1.

D. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.
2. Legend: Indicates voltage and service.

B. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

C. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend indicating type of underground line.

D. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

E. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

F. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.

G. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.

H. Brass or Aluminum Tags: 2 by 2 by 0.05-inch metal tags with stamped legend, punched for fastener.

2.2 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes. Letters shall be 1/2” high minimum and the nameplate material colors shall be as follows:

1. Blue surface with white core for 120/208 volt equipment.
2. Black surface with white core for 277/480 volt equipment.
3. Bright red surface with white core for all equipment related to fire alarm system.
4. Dark red (burgundy) surface with white core for all equipment related to security.
5. Orange surface with white core for all equipment related to telecommunications systems.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.

E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
1. Circuits with More Than 600 V: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches high, stenciled with paint at 10-foot intervals over a continuous, painted orange background.

C. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime surfaces using type of primer specified for surface.
3. Apply one intermediate and one finish coat of enamel.

D. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:

1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
3. Apply the following colors to the systems listed below:

a. Fire Alarm System: Red.
b. Fire-Suppression Supervisory and Control System: Red and yellow.
c. Combined Fire Alarm and Security System: Red and blue.
d. Security System: Blue and yellow.

e. Mechanical and Electrical Supervisory System: Green and blue.
f. Telecommunication System: Green and yellow.

E. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

F. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
2. Concealed Boxes: Plasticized card-stock tags.
3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
4. All receptacle and light switch cover plates shall have circuit identification label neatly applied to the device cover plate.

G. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker.

H. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.

1. Color-code 208/120-V system as follows:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White.
e. Ground: Green.

2. Color-code 480/277-V system as follows:

a. Phase A: Brown
b. Phase B: Orange.
c. Phase C: Yellow.
d. Neutral: Natural gray.
e. Ground: Green.

3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3

inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

I. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch- steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

J. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

K. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high. Use nameplate colors specified in paragraph 2.2B. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Electrical switchgear and switchboards.
4. Emergency system boxes and enclosures.
5. Disconnect switches.
6. Enclosed circuit breakers.
7. Motor starters.
8. Push-button stations.
9. Contactors.
10. Control devices.
11. Transformers.
12. Fire alarm master station or control panel.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following lighting control devices:

1. Indoor occupancy sensors.
2. Lighting contactors.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.3 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. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Leviton (Owner preferred)
2. Lutron
3. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. All occupancy sensors shall be dual technology, extended range type.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

4. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
5. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
7. Bypass Switch: Override the on function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

2.2 LIGHTING CONTACTORS

A. Description: Electrically operated and mechanically held, combination type complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.

B. All exterior lighting circuits to be routed through a lighting contactor to be installed in the main ground level electrical room. Contactor shall be controlled by a single photo cell installed in an inconspicuous exterior location (roof) where not impacted by ambient light. A maintenance by-pass switch shall be installed in parallel with the photo cell and adjacent to the lighting contactor. Provide and install a contactor having poles equal to the number of exterior lighting circuits noted on plans plus 2.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by occupancy sensors at each sensor.

B. Label contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

END OF SECTION 260923

SECTION 262200 -DRY-TYPE TRANSFORMERS (1000 V AND LESS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes dry-type distribution and specialty transformers rated 1000 V and less.

1.3 SUBMITTALS

A. Product Data: Include data on features, components, ratings, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.

B. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.

C. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.

D. Maintenance Data: For transformers to include in the maintenance manuals.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

B. Comply with IEEE C2.

C. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide transformers by one the following:

1. GE Electrical Distribution & Control.
2. Square D; Groupe Schneider.
3. Siemens
4. Eaton Cutler Hammer

2.2 TRANSFORMERS, GENERAL

A. Description: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.

B. Cores: Grain-oriented, nonaging silicon steel.

C. Coils: Continuous windings without splices, except for taps.

D. Internal Coil Connections: Brazed or pressure type.

E. Enclosure: Class complies with NEMA 250 for the environment in which installed.

2.3 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

A. Comply with NEMA ST 20 and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Windings: One coil per phase in primary and secondary.

D. Enclosure: Indoor, ventilated.

E. Insulation Class: 185 or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.

1. Rated Temperature Rise: 80 deg C maximum rise above 40 deg C.

F. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:
1. Taps, 3 through 10 kVA: Two 5-percent taps below rated high voltage.
2. Taps, 15 through 500 kVA: Six 2.5-percent taps, 2 above and 4 below rated high voltage.
3. Taps, 750 kVA and Above: Four 2.5-percent taps, 2 above and 2 below rated high voltage.

G. Wall-Mounting Brackets: Manufacturer's standard brackets for transformers up to 75 kVA.

2.4 FINISHES

A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

B. Outdoor Units: Comply with ANSI C57.12.28.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Design and routine tests comply with referenced standards.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project if specified sound levels are below standard ratings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with safety requirements of IEEE C2.

B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.

C. Identify transformers and install warning signs according to Division 16 Section "Electrical Identification."

3.2 GROUNDING

A. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer.

B. Comply with Division 16 Section "Grounding" for materials and installation requirements.

3.3 CLEANING

A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.4 ADJUSTING

A. After installing and cleaning, touch up scratches and mars on finish to match original finish.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.

END OF SECTION 262200

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:

1. Lighting and appliance branch-circuit panelboards.
2. Distribution panelboards.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

F. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

C. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
   a. Square D Co.
   b. General Electric Co.
   c. Siemens
   d. Eaton Cutler Hammer

2.2 FABRICATION AND FEATURES

A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.

B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

E. Bus: Hard-drawn copper, 98 percent conductivity

F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.

G. Equipment Ground Bus: Hard drawn copper adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

H. Isolated Equipment Ground Bus: Hard drawn copper adequate for branch-circuit equipment ground conductors; insulated from box.

I. Extra-Capacity Neutral Bus: Hard drawn copper neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

J. Split Bus: Vertical buses divided into individual vertical sections.

K. Gutter Barrier: Arrange to isolate individual panel sections.

L. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

A. Doors: Front mounted secured with vault-type latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker, bolt on type.

C. Branch overcurrent protective devices shall be one of the following:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: Bolt on type NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with **5** mA trip sensitivity.
6. All 120V, 15 and 20A circuits in dwelling units shall be on Arc Fault Circuit Interrupter type circuit breakers. All circuits shall have a dedicated neutral.

B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

E. Install filler plates in unused spaces.

F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.4 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

A. Product Data: For each product specified.

B. Maintenance Data: For materials and products to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NEMA WD 1.

C. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. Duplex receptacles shall be of the grounding type arranged for back and side wiring, with separate single or double grounding terminals. Receptacles shall be straight blade rated 20 amperes, 125 volt. The face configuration shall comply to the NEMA standard No. WDI.101968 and shall be approved third party listed. Self grounding or automatic type grounding receptacles are not acceptable in lieu of receptacle with separate hex head green grounding screw lugs and a direct green insulated conductor connection to the equipment grounding system.

B. Receptacles shall be heavy duty specification grade mounted vertically. Receptacles mounted over counters, back splashes, etc. shall be mounted horizontally.

C. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, 20 ampere rated, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit.

D. Industrial Heavy-Duty Receptacle: Comply with IEC 309-1.

E. Hazardous (Classified) Location Receptacles: Comply with NEMA FB 11.

2.2 SWITCHES

A. Snap Switches: Heavy-duty, quiet type, single pole, three way, or four way as indicated on the drawings. Switches shall be grounding type with hex head grounding screw rated 20 amperes, 120/277 volts A.C. only. All switches shall have quiet operating mechanism without the use of mercury. All switches shall be listed by an approved third party agency approved for the voltage and amperage indicated.

B. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.

1. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable rotary knob, toggle, or slide; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch wire connecting leads.
2. Fluorescent Lamp Dimmers: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming to a maximum of 1 percent of full brightness.

2.3 WALL PLATES

A. Single and combination types match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: 0.04-inch- thick, Type 302, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.

2.4 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartmentation: Barrier separates power and signal compartments.

C. Housing Material: Die-cast aluminum, satin finished.

D. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

E. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

2.5 MULTIOUTLET ASSEMBLIES

A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. Raceway Material: Nonmetal.

D. Wire: No. 12 AWG.

2.6 FINISHES

A. Color: Ivory, unless otherwise indicated or required by Code.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies plumb and secure.

B. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

C. Do not share neutral conductor on load side of dimmers.

D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor. All circuits shall have a green grounding conductor.

B. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.

3.4 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity and ground continuity.

B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

C. Replace damaged or defective components.

3.5 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

3.6 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

D. Field quality-control reports.

E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Square D Co.
   2. General Electric Co.; Electrical Distribution & Control Division.
   3. Siemens
   4. Eaton Cutler Hammer

2.2 ENCLOSED SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type Heavy Duty (HD) with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

C. Fusible safety switches with short circuit withstand ratings of 100K Amp or 200K Amp require Class R or Class J rejection fuse block feature. (Comply with NEC Article 110-9 and 240-60b)

D. Select/Provide Fuses per the following criteria

   1. Service Entrance and Feeder Circuits over 600A: Class L, U/L listed, current limiting with 200K Amp interrupting capacity.
   2. Service Entrance and Feeder Circuits 600A and less: Class RK1 or J, U/L listed, current limiting with 200K Amp interrupting capacity.
   3. Motors, Motor Controller & Transformer Circuits: Class RK5, U/L listed, current limiting time delay with 200K Amp interrupting capacity
   4. Individual Equipment where fault current does not exceed 50 KA: Class K5, U/L listed, with 50KA interrupting capacity

E. Spare Fuses: Provide 10% spare fuses of each size and type required with a minimum of one set of each.

2.3 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

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

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section.

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Repair exposed surfaces to match original finish.

END OF SECTION 262816

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. See Division 26 Section "Network Lighting Controls" for manual or programmable control systems employing low-voltage control wiring or data communication circuits.

C. See Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

D. See Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

D. Field quality-control test reports.

1.3 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. Comply with NFPA 70, 2020 Edition as adopted by the State of North Carolina.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
2. Lens Thickness: 0.125 inch minimum, unless greater thickness is indicated.

2.3 Interior LED Fixture

A. Application and types
1. Recessed Troffers Grid, Modular and Z Spline
2. Linear

B. Construction/Finish
1. No visible welding, no plane-protruding screws, latches, springs, hooks, rivets or plastic supports viewed from the occupied (room) side are allowed.
2. Recessed, Type IC (intended for insulation contact)

C. Maintenance

1. Power supplies/drivers/ballasts, LED arrays, boards or light engines shall be easily field replaceable using common hand tools (e.g., screwdrivers, pliers, etc.) and without uninstalling the luminaire

D. Electrical and Photometric Requirements
   1. Electrical
      a. Operating voltage: 24 Vdc, 120 Vac at 60 Hz, 277 Vac at 60Hz, or universal voltage (120, 220/240, 277 Vac at 50/60 Hz)
      b. Power factor: ≥ 0.90 (at full luminaire output and across specified voltage range)
      c. Total harmonic distortion: $\leq 20\%$ (at full luminaire output and across specified voltage range)
      d. Transient and surge protection: ANSI C62.41-2002 Category A surge protection standards up to and including 2.5 kV for interior fixtures.
      e. Sound: Class A not to exceed a measured value of 24dB
      f. Maximum standby power: 1W
      g. Warranty: 10 year non-prorated on complete fixture including driver.
      h. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 10% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.

   2. LED Power Supply/Driver
      a. Driver efficiency (at full load):
         1) $\geq 85\%$ for drivers capable of ≥ 50 watts
         2) $\geq 80\%$ for drivers capable of < 50 watts
         3) Federal Communications Commission (FCC) compliance: FCC 47 Part 15 Non-Consumer limits for EMI/RFI emissions

   3. Temperature Rating
      a. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
      b. The operating temperature range shall be 0°C to 25°C.

   4. Thermal management
      a. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.

      b. The LEDs manufacturer's maximum junction temperature for the expected life shall not be exceeded at the average operating ambient temperature.

      c. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient temperature.

      d. The driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating temperature.

      e. Thermal management shall be passive by design. The use of fans or other mechanical cooling devices shall not be allowed.

5. Flicker criteria
    a. Shall comply with IESNA standards for flicker and IEEE PAR1789 Recommended Practice to limit flicker to acceptable levels. Flicker requirements shall be applied through the full range of dimming for dimmable fixtures.

6. EMI/RFI
    a. The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI Emissions.

7. Inrush Current
    a. Comply with NEMA 410, Table 2.

8. Manufacturer Criteria
    a. Manufacturers shall be firms regularly engaged in the manufacture of recessed lighting fixtures of types and ratings required, who have a service organization in the continental US, and whose products have been satisfactorily used in similar service for not less than 5 years. The manufacture of the fixtures shall comply with the provisions of all applicable code and standards. All fixtures shall be tested before shipping.

9. Photometric & Colorimetric Performance
    a. Photometric
        1) Minimum initial delivered luminaire lumens
            a) Per fixture schedule on plans.

        2) Minimum Luminaire Efficacy (LE) or Luminaire Efficacy Rating (LER):
            a) Per fixture schedule on plans.
            b) Provide Energy Star and DLC certified products.

    b. Colorimetric (See plans for fixture requirements)
        1) Correlated Color Temperature (CCT): Only allowed CCTs are 2700K, 3000K, 3500K, 4000/4100K, 4500K and 5000K.
        2) Acceptable tolerances as provided in ANSI C78.377-2015 (LED).
        3) Color Rendering Index (CRI) [Ra] $\geq$ 80 with a positive R9 value.
        4) Color shift of no less than $\Delta u'v' < 0.007$ during the warranty period.

2.4 Exterior LED Fixture

A. Application
1. Street and Walkway Luminaires
2. Exterior Wall Luminaires
3. Parking Garage Luminaires
4. Perimeter and Security Lighting

B. Construction/Finish
1. Construction/Finish/Appearance shall be as noted in the fixture schedule and all components shall be suitable for the environmental exposure.
2. Lenses shall be UV Stabilized or UV Resistant if exposed to sunlight.

3. All outdoor fixtures shall be suitable for damp or wet location as noted on plans. Luminaires intended for use in wet locations should also have at least an IP65 rating as defined by IEC 60598.

C. Maintenance
   1. Fixtures with replaceable and upgradable components are preferred. Power supplies/drivers/ballasts, LED arrays, boards or light engines shall be easily field replaceable using common hand tools (e.g., screwdrivers, pliers, etc.) and without uninstalling the luminaire

D. Electrical and Photometric Requirements
   1. Electrical
      a. Operating voltage: 24, 48, 60, 380 Vdc, 120 , 208, 240, 277, 480Vac at 60Hz, or universal voltage (120, 208, 220/240, 277, 480 Vac at 60 or 50/60 Hz). Fixture voltage should match the application voltage.
      b. Power factor: ≥ 0.90 (at full luminaire output and across specified voltage range)
      c. Total harmonic distortion: $\leq 20\%$ (at full luminaire output and across specified voltage range)
      d. Transient and surge protection: ANSI C62.41-2002 Category A surge protection should be a minimum of 10kV for exterior fixtures utilizing devices compliant with UL 1449.
      e. Sound: Class A not to exceed a measured value of 24dBa
      f. Maximum standby power: 1W

E. Warranty: 10 year non-prorated on complete fixture including driver.

F. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 10% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.

G. Temperature Rating
   1. The ambient operating temperature range shall be -20°C to 40°C.

H. Thermal management
   1. The thermal management (of the heat generated by the LEDs) shall be sufficient capacity to assure proper operation of the luminaire over the expected useful life.
   2. The LEDs manufacturer's maximum junction temperature for the expected life shall not be exceeded at the average operating ambient temperature.
   3. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient temperature.
   4. The driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating temperature.
   5. Thermal management shall be passive by design. The use of fans or other mechanical cooling devices shall not be allowed.

I. Flicker criteria
   1. Shall comply with IESNA standards for flicker and IEEE PAR1789 Recommended Practice to limit flicker to acceptable levels. Flicker requirements shall be applied through the full range of dimming for dimmable fixtures.

J. EMI/RFI
1. The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI Emissions.

K. Inrush Current
1. Comply with NEMA 410, Table 2.

L. Manufacturer Criteria
1. Manufacturers shall be firms regularly engaged in the manufacture of recessed lighting fixtures of types and ratings required, who have a service organization in the continental US, and whose products have been satisfactorily used in similar service for not less than 5 years. The manufacture of the fixtures shall comply with the provisions of all applicable code and standards. All fixtures shall be tested before shipping.

M. Control Criteria
1. All installed outdoor lighting shall be controlled by a photocontrol or astronomical time switch control that automatically turns OFF the outdoor lighting when daylight is available.

N. Photometric & Colorimetric Performance (See plans for fixture requirements)
1. Photometric
a. Minimum initial delivered luminaire lumens
1) Per fixture schedule on plans.

b. Minimum Luminaire Efficacy (LE) or Luminaire Efficacy Rating (LER):
1) Per fixture schedule on plans.
2) Provide Energy Star and DLC certified products.

c. The lumen output of the fixture shall not decrease more than 20% over the defined operational lifetime of the fixture.

2. Colorimetric
a. Color temperature range shall be in the 4,000–5,100 Kelvin.
b. Fixtures shall have a minimum color rendering as noted in plans.

2.5 EMERGENCY EXIT LUMINAIRE

A. General Requirements: Comply with UL 924 and the following:

1. Emergency Exit fixtures shall be completely self-contained, provided with maintenance-free 12 volt battery, automatic charger, and other features. Luminaire shall be third-party listed as emergency lighting equipment, and meet or exceed the following standards: NEC, NC Building Code, Volume X Energy Code, NFPA-101, and NEMA standards.

2. Fixture shall have a three year warranty with an additional two more years prorated warranty for the battery. Warranty shall start from the date of project acceptance.

B. Internally Lighted Signs: As follows:
   1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life. Maximum LED failure rate shall be 25% within a seven (7) year period; otherwise, if exceeded manufacturer shall replace the complete unit at no charge to the owner.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

   1. Battery: Sealed, maintenance-free, with a minimum of 90 minutes operating endurance and a normal life expectancy of 10 years. Battery shall be a high temperature type with an operating range of 0°C to 60°C and contain a resealable pressure vent, a sintered + positive terminal and – negative terminal.
   2. Charger: Fully automatic solid-state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90 minutes under full load. The unit shall be activated when the voltage drops below 80 per cent. A low voltage disconnect switch shall be included if LEAD Battery is used to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage.
   3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
   4. Provide a pilot light to indicate the unit is connected to AC power. The battery shall have high rate charge pilot unless self diagnostic type. A test switch shall be included to simulate the operation of the unit upon loss of AC power by energizing the lamps from the battery. The simulation must also exercise the transfer relay.
   5. Test each emergency lighting unit and exit sign after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes. The battery test shall be done 10 days prior to final inspection by the State Construction Office. Any unit which fails the test must be repaired or replaced and tested again. Copy of the test report must be sent to the State Construction Office.

2.6 EMERGENCY EGRESS LUMINAIRE

A. General Requirements: Comply with UL 924 and the following:
   1. Emergency Egress luminaires shall be completely self-contained, provided with maintenance-free 12 volt battery, automatic charger, two lamps, and other features. Luminaire shall be third-party listed as emergency lighting equipment, and meet or exceed the following standards: NEC, NC Building Code, Volume X Energy Code, NFPA-101, and NEMA standards.
   2. Fixture shall have a three year warranty with an additional two more years prorated warranty for the battery. Warranty shall start from the date of project acceptance.
   3. Battery: Sealed, maintenance-free, with a minimum of 90 minutes operating endurance and a normal life expectancy of 10 years. Battery shall be a high temperature type with an operating range of 0°C to 60°C and contain a resealable pressure vent, a sintered + positive terminal and – negative terminal.
   4. Charger: Fully automatic solid-state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90

minutes under full load. The unit shall be activated when the voltage drops below 80 per cent. A low voltage disconnect switch shall be included if LEAD Battery is used to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage.

5. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
6. Provide a pilot light to indicate the unit is connected to AC power. The battery shall have high rate charge pilot unless self diagnostic type. A test switch shall be included to simulate the operation of the unit upon loss of AC power by energizing the lamps from the battery. The simulation must also exercise the transfer relay.
7. Test each emergency lighting unit and exit sign after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes. The battery test shall be done 10 days prior to final inspection by the State Construction Office. Any unit which fails the test must be repaired or replaced and tested again. Copy of the test report must be sent to the State Construction Office.
8. Emergency battery ballasts integral to normal lighting fixtures shall be high lumen output. Battery ballasts shall be wired with both switched and unswitched circuit legs in order to allow normal switching of emergency lamps.

2.7 LAMPS

A. LED lamps: 3500 K and 85 CRI, unless otherwise indicated in plans. 50,000 hours minimum lamps life and 5 year minimum warranty.

2.8 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.

2.9 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Where a recessed downlight fixture displaces a section or part of ceiling tile fixture shall be supported at two diagonally opposite corners with the same type of wire used to support the lay-in ceiling track. Attach one end of the wire to the corner of the fixture and

the other end to the building structure. The lay-in fixture shall then be screwed to the main runners of the lay-in ceiling track at all four corners using sheet metal screws. For fire rated suspended ceiling, luminaire shall be supported to the building structure per the ceiling design criteria, luminaire shall then be screwed to the main runners of the suspended ceiling at all four (4) corners using sheet metal screws.

2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

C. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

3.2 CONNECTIONS

A. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Malfunctioning Fixtures and Components: Replace or repair, then retest.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 265100

DIVISION 28

ELECTRONIC SAFETY & SECURITY

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes a turn-key fire alarm system with manual stations, detectors, signal equipment, controls, devices, cabling, raceways, control panel(s), booster panel(s) and all accessory equipment required for a fully functional system.

1.2 DEFINITIONS

A. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

B. Authority Having Jurisdiction (AHJ) Defined, Building Permits.
   1. For private sector or local government projects the AHJ is the local government entity that approves project plans, issues building permits, and inspects construction.

1.3 SYSTEM DESCRIPTION

A. General: The system is to be the addressable type, with a 24vdc nominal operating voltage. All equipment supplied must be specifically listed for its intended use and shall be installed in accordance with any instructions included in its listing.

B. The system is to have multiple access levels so owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. How to do this must be included in the training required to be given to the owner's designated personnel and must also be part of the written documentation provided by the fire alarm equipment supplier.

C. Network operations shall be via communication links that connect all network nodes and include data transfer. All communications trunk wiring shall be electrically supervised.

D. The Fire Alarm Control Unit (FACU) shall be located for convenient, rapid access. When not located in a public or normally occupied area, a Remote Annunciator (RA) with audible-visible trouble indication is required. Consult with facility manager and the local fire official, prior to locating the FACU and any RA.

E. The FACU and all other control equipment locations, including any transponders, sub-panels, and booster power supplies, must be protected by a spot type smoke detector located within 15 feet of the equipment (measured horizontally

F. A supervised "AHU Shutdown Defeat" toggle switch must be provided in/adjacent to the FACU or as a key-operated function in the Remote Annunciator (if provided). If the RA option is utilized, provide an informative engraved label at the FACU about this function. The switch

must cause a system "trouble" indication when it's placed in the off-normal ("Shutdown Defeated") position.

G. Each addressable fire alarm system must include an LED-type "zone" annunciator at (or in) the FACU, or in another location if acceptable to the AHJ. As a minimum, this annunciator is to indicate the specific type of alarm or supervisory signal (smoke detector, waterflow, sprinkler valve closed, etc.), for groups of addressable devices. The area ("zone") that is represented by each LED shall not exceed 1 floor or 22,500 square feet, and must not cross building fire walls or smoke compartments.

H. The following protection against voltage transients and surges must be provided by the fire alarm equipment supplier, and installed by the contractor:

a. On AC Input: A feed-through (not a shunt-type) branch circuit transient arrestor such as the EFI HWM-120, Leviton OEM-120EFI, Northern Technologies TCS-HW, Transtector ACP100BWN3, or any equivalent UL Listed device submitted to and approved by the electrical design engineer. Install suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the arrestor in suppressing voltage transients.

b. On DC Circuits Extending Outside Building: Adjacent to the FACU, and also near point of entry to outlying building, provide "pi"-type filter on each leg, consisting of a primary arrestor, series impedance, and a fast acting secondary arrestor that clamps at 30v-40v. Some acceptable models: Innovative Technology D2S33-2ML, Simplex 2081-9027 and 2081-9028, Transtector TSP8601, Ditek DTKxLVL series, Citel America B280-24V, and Northern Technologies DLP-42. Devices using only MOV active elements are not acceptable

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show details of graphic annunciator.

1. Wiring Diagrams: Detail wiring and differentiate between manufacturer-installed and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified.
2. Battery: Sizing calculations.
3. Device Address List: Coordinate with final system programming.
4. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
5. Submit complete Shop Drawings to the engineer for review, prior to performing any work. These shall clearly demonstrate compliance with the engineer’s plans and specifications, which have a System Response Matrix showing the fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal. NOTE: Any non-compliant features must be fully described. Engineer’s approval (with or without corrections) of contractor’s Shop Drawings, samples, cut sheets, etc., is for general conformance with the contract documents and design concept. It shall not relieve

the contractor of responsibility for full compliance with the project plans and specifications.

6. The fire alarm system shall comply with applicable provisions of the NC Building Code (available for sale at NCDoI), and the National Fire Alarm Code (NFPA 72).
7. Furnish all parts, materials, and labor customarily required or provided for a complete and operating system, in accordance with all requirements applicable, even if each needed item is not specifically shown or described in the project plans or specifications

C. Operating Instructions: For mounting at the FACU.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the FACU manufacturer for both installation and maintenance of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance.

C. Source Limitations: Obtain fire alarm system components through one source from a single manufacturer.

D. Compliance with Local Requirements: Comply with applicable building code, local ordinances and regulations, and requirements of authorities having jurisdiction.

E. Comply with NFPA 72 current edition as referenced in the 2018 North Carolina Building Code.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses (If Used)..... 2 of each size in system
2. Manual Fire Alarm Boxes.....2% of installed quantity
3. Addressable Control Relays.....4% of installed quantity
4. Indoor Horns/Speakers with Strobes Lights..... 4% of installed quantity
5. Indoor Strobe-only Notification Appliances.....4% of installed quantity
6. Monitor Modules (Addressable Interface).....4% of installed quantity
7. Isolation Modules / Isolation Bases..... 4% of installed quantity
8. Addressable, Electronic Heat Detectors.....4% of installed quantity
9. Spot-Type Smoke Detectors / Sounder Bases.....6% of installed quantity

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Notifier
2. Gamewell
3. Silent Knight

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Control of System: By the FACU.

B. System Supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.

C. Priority of Signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.

D. Noninterference: A signal on one zone shall not prevent the receipt of signals from other zones.

E. System Reset: All zones are manually resettable from the FACU after initiating devices are restored to normal.

F. Transmission to Remote Alarm Receiving Station: Automatically route alarm, supervisory, and trouble signals to a remote alarm station by means of a digital alarm communicator transmitter and telephone lines.

G. System Alarm Capability during Circuit Fault Conditions: System wiring and circuit arrangement prevent alarm capability reduction when an open circuit, ground or wire-to-wire short occurs, or an open circuit and a ground occur at the same time in an initiating device circuit, signal line circuit, or notification-appliance circuit.

H. Loss of primary power at the FACU initiates a trouble signal at the FACU and the annunciator. An emergency power light is illuminated at both locations when the system is operating on the secondary power supply.

I. Basic Alarm Performance Requirements: Unless otherwise indicated, operation of a manual station, automatic alarm operation of a flame or heat detector, operation of a sprinkler flow device, or verified automatic alarm operation of a smoke detector initiates the following:

1. Notification-appliance operation.
2. Identification at the FACU and the remote annunciator of the device originating the alarm.
3. Transmission of an alarm signal to the remote alarm receiving station.
4. Unlocking of electric door locks in designated egress paths.
5. Release of fire and smoke doors held open by magnetic door holders.
6. Recall of elevators.
7. Shutdown of fans and other air-handling equipment serving zone when alarm was initiated.
8. Recording of the event in the system memory.

J. Alarm Silencing, System Reset and Indication: Controlled by switches in the FACU and the remote annunciator.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

K. Water-flow alarm switch operation initiates the following:

1. Notification-appliance operation.
2. Flashing of the device location-indicating light for the device that has operated.

L. Water-flow alarm for connection to sprinkler in an elevator shaft and elevator machine room shuts down elevators associated with the location without time delay.

1. A field-mounted relay actuated by the fire detector or the FACU closes the shunt trip circuit and operates building notification appliances and annunciator.

M. Smoke detection for zones or detectors with alarm verification initiates the following:

1. Audible and visible indication of an "alarm verification" signal at the FACU.
2. Activation of a listed and approved "alarm verification" sequence at the FACU and the detector.
3. Recording of the event by the system.
4. General alarm if the alarm is verified.
5. Cancellation of the FACU indication and system reset if the alarm is not verified.

N. Sprinkler valve-tamper switch operation initiates the following:

1. A supervisory, audible, and visible "valve-tamper" signal indication at the FACU and the annunciator.
2. Flashing of the device location-indicating light for the device that has operated.
3. Recording of the event by the system.
4. Transmission of supervisory signal to remote alarm receiving station.

O. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACU causes the selection of specific addressable smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. Same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity-adjustment schedule changes are recorded in system memory.

P. Removal of an alarm-initiating device or a notification appliance initiates the following:

1. A "trouble" signal indication at the FACU and the annunciator for the device or zone involved.
2. Recording of the event by the system.
3. Transmission of trouble signal to remote alarm receiving station.

Q. FACU Alphanumeric Display: Plain-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices

originating the report. Display monitoring actions, system and component status, system commands, programming information, and data from the system's historical memory.

2.3 MANUAL PULL STATIONS

A. Description: Fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.

1. Single-action mechanism initiates an alarm.
2. Station Reset: Key or wrench operated; double pole, double throw; switch rated for the voltage and current at which it operates.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.
5. Integral Addressable Module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACU.

2.4 SMOKE DETECTORS

A. General: Automatic fire/smoke detectors used shall be selected in accordance with Table I, Applications Matrix for Selecting Detection Devices, which follows this Section

B. All addressable spot type and duct smoke detectors shall be the analog type and the alarm system shall automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors. This feature must be armed and sensitivities set prior to acceptance of the system.

C. Dormitory and student apartment sleeping rooms and suite areas shall have smoke detectors with "sounder" bases controlled by the FACU, to assure audibility, unless the AHJ approves otherwise. Program the detectors so that sleeping room smoke initiates local alarm in the room, pre-signal indication at the FACU, and notification at the Supervising Station. Any common area alarm must cause immediate general alarm throughout the building, including all sounder bases in the sleeping rooms.

D. Spot-type detectors must be the plug-in type, with a separate base (not a mounting ring), to facilitate their replacement and maintenance. The base shall have integral terminal strips for circuit connections, rather than wire pigtails (see 6.5 for details). Each detector or detector base shall incorporate an LED to indicate alarm.

E. Spot-type smoke detectors shall have a built-in locking device to secure the head to the base, for tamper resistance. For detectors mounted within 12 feet of the floor, activate this lock after the system has been inspected and given final acceptance.

F. Spot-type smoke detectors shall not be used where ceiling height exceeds 25 feet because it makes access for maintenance very difficult and could impede response.

G. Unless suitably protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors must be replaced.

H. A detector installed where accidental damage or deliberate abuse is expected shall be provided with a guard that is listed for use with it and is acceptable to the AHJ.

I. Identification of individual detectors is required. Assign each a unique number as follows, in sequence starting at the FACU: (Addressable Loop # -- Device #). Put on the as-built plans, and also permanently mount on each detector's base so that it's readable standing on the floor below without having to remove the smoke detector. Exception: For detectors with housings (i.e., air duct, projected beam, air sampling, flame), apply the identification to a suitable location on exterior of their housing.

J. All air duct/plenum detectors must have a Remote Alarm Indicator Lamp (RAIL) installed in the nearest corridor or public area and identified by an engraved label affixed to the wall or ceiling. Duct smoke detectors are permitted to be installed only inside an air duct. It is not appropriate to mount them in front of a return air opening. Duct detectors shall also be installed in a manner that provides suitable, convenient access for required periodic cleaning and calibration.

K. Duct detector sampling tubes shall extend the full width of the duct. Those over 36 inches long must be provided with far end support for stability.

L. Each duct detector installation shall have a hinged or latched duct access panel, 12x12 inches minimum, for sampling tube inspection and cleaning. Indicate airflow direction on the duct, adjacent to the detector, using stencil or permanent decal.

2.5 NOTIFICATION APPLIANCES

A. Alarm notification appliances, both audible and visible, shall comply with NFPA 72 requirements for intensity and placement. The standard audible evacuation signal shall be the ANSI S3.41 three-pulse temporal pattern described in NFPA 72, except the ANSI signal shall not be used where the planned action during a fire emergency is to relocate occupants, or protect them in place, instead of immediate evacuation (e.g., some health care facilities, prisons). Strobe lights shall be selected and located per NFPA 72 and all those installed in a single space must be synchronized.

B. Alarm notification appliance (NAC) circuits shall be NFPA 72 Style Y (Class B). The load connected to each circuit must not exceed 80% of rated module output and the coverage of each circuit shall not exceed 3 floors (to limit the effect of faults, and to facilitate trouble-shooting). The NAC voltage drop during alarm must not exceed **14**% of the voltage measured across the batteries at that time. To achieve this, the design must consider wire size, length of circuit, device load, inherent voltage loss within the FACU's power supply, etc. The contractor shall use power outage testing to verify that the NAC circuit was designed and installed properly.

2.6 REMOTE DEVICE LOCATION-INDICATING LIGHTS AND IDENTIFICATION PLATES

A. Description: LED indicating light near each smoke detector that may not be readily visible, and each sprinkler water-flow switch and valve-tamper switch. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.7 MAGNETIC DOOR HOLDERS

A. For life safety reasons, any exit or exit access doors that are locked to delay egress, in accordance with 1003.3.1.8.2 of the NC Building Code (2002 edition), must utilize one of the following types of locking hardware:
   1. Magnetic Lock (fail-safe) utilizing a 24vdc magnet and contact plate
   2. Electro-Mechanical Lock (fail-safe) with reverse bevel type dead bolt.

B. These doors must immediately unlock upon any fire alarm signal, loss of building AC power, disablement of the fire alarm system (defined as loss of its 24vdc power), or upon manual operation of an unlock switch at a constantly attended location.

C. Where installed on smoke or fire doors, power failure shall cause these mechanisms to default to the egress mode with normal mechanical latching.

D. Smoke doors are permitted to be held open by 24vdc wall/floor-mounted magnets powered by the FACU, and released upon alarm. The resulting current drain shall be included in the standby battery calculations **or** the system must be programmed to drop the door hold-open magnet load 60 seconds after the loss of 120vac power.

E. For life safety reasons, all rolling steel fire doors must descend at a constant rate of 1 foot/second maximum, whether released by their thermal link or closed by FACU command. Also, in response to strong requests from many facility managers, these fire doors must either: (1) Automatically reset when raised to their normal position, **or** (2) Have a motor down - motor up mechanism controlled by the FACU.

2.8 CENTRAL FACU

A. Cabinet: Lockable steel enclosure. Arrange interior components so operations required for testing or for normal maintenance of the system are performed from the front of the enclosure. If more than one unit is required to form a complete control panel, fabricate with matching modular unit enclosure to accommodate components and to allow ample gutter space for field wiring and interconnecting panels.

2.9 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACU for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACU, including acknowledging, silencing, reset, and test.

B. Display Type and Functional Performance: Alphanumeric display same as the FACU. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACU.

C. Graphic Display Panel for Remote Annunciator: Wall-mounted engraved panel indicating the building floor plan with a "You Are Here" designation. Engrave zone, area, and floor designations on the face of the panel.

1. Materials: Satin-finished stainless steel or brushed aluminum.
2. Floor Plan and Zone Boundary Lines: Engraved in the surface and filled with colored paint. Floor plan lines are black and 1/4 inch wide.
3. Engraved Legends: 1/4-inch- high minimum, in letters filled with red paint.
4. Mounting: Adjacent to remote annunciator.

2.10 EMERGENCY POWER SUPPLY

A. Systems are to be provided with a separate and independent source of secondary power with a minimum of 60 hours secondary power capacity, plus 5 minutes of full alarm load. Provide additional battery and charger capacity unless calculations demonstrate that the existing batteries and charger are sufficient.

1. Include a copy of system battery sizing calculations with the shop drawing submittal to the engineer. Use manufacturer's battery discharge curve to determine expected battery voltage after 60/24 hours of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected voltage drop at EOL, based on conductor resistance per manufacturer's data sheet or NEC 2000, Table 8. Double the ohms per foot since two conductors are required to power the circuit. Also, add any inherent voltage drop caused by the system's power supply
2. The voltage drop at EOL must not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. (Typically, for a 24 volt system, this limits the voltage drop from the battery to the EOL to 3 volts). Determine "worst case" voltage at far end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. The result must be no less than the minimum listed operating voltage for the alarm notification appliances used.
3. All of these calculations must be placed on a dedicated sheet of as-built drawings, for future reference by fire alarm service technicians. NAC voltage drop is to be verified during system tests

B. General: Components include nickel-cadmium battery, charger, and an automatic transfer switch.

1. Battery Nominal Life Expectancy: 20 years, minimum.

C. Battery Capacity: Comply with NFPA 72.

D. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger recharges them completely within four hours. Charger output is supervised as part of system power supply supervision.

E. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.11 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a multiplex system address for listed fire and sprinkler alarm-initiating devices with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to the elevator controller to initiate elevator recall or to a circuit-breaker shunt trip for power shutdown.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled under UL 864 and NFPA 72. Dual Path Communicator with IP connection and cellular dialer. System shall allow either technology path to stand alone as the primary dialer and the alternate path to serve as back-up if desired.

B. Each system with automatic fire detection, or which monitors a sprinkler system, shall be equipped with an addressable point reporting Digital Alarm Communicator Transmitter (DACT) for transmission of fire alarm, supervisory, and trouble signals to a Central Station, Remote Supervising Station, or Proprietary Supervising Station. The following signals shall be reported as applicable.;
1. Fire Alarm
2. Sprinkler Waterflow Alarm
3. Sprinkler Valve Tamper (Closed) Supervisory Signal
4. Sprinkler Low Temperature / Air Pressure Supervisory Signal
5. Fire Alarm System AC Power Trouble (only if 120vac interrupted for 8 hours)

C. The precedence of signals transmitted to the Supervising Station shall be as follows:
1. Fire Alarm
2. Supervisory Signal
3. Trouble Signal
4. Fire Alarm System AC Power Trouble signal must not be sent unless maintained for8 hours, to avoid nuisance transmissions to the supervising station from short term 120vac power outages (from switching transients, thunderstorms, etc.).

D. The Contractor must provide a communicator that is compatible with the owner's alarm receiving equipment, or the Supervising Station selected by the owner, as applicable. Contractor shall program the PROM, connect each DACT to the line(s) provided to him, and verify proper signal receipt by the Supervising Station.

E. Coordinate programming and testing with the owner.

F. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

2.13 GUARDS FOR PHYSICAL PROTECTION

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by the manufacturer of the device.
2. Finish: Paint of color to match the protected device.

2.14 WIRE

A. Non-Power-Limited Circuits: Stranded-copper conductors type THHN/THWN with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 14 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

B. Power-Limited Circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.

C. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair.

D. All cable shall be plenum rated.

2.15 CONDUIT

A. All conduit and fittings shall be minimum 3/4 inch size, with compression type fittings having insulated throats.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Connect the FACU with a disconnect switch or circuit breaker with lockable handle or cover.

B. Manual Pull Stations: Mount semiflush in recessed back boxes.

C. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Combine audible and visible alarms at the same location into a single unit.

D. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

3.2 WIRING INSTALLATION

A. Wiring Method: Conduit runs up wall from device to 6" above ceiling and turns out to above accessible corridor ceiling w/ 90 degree bend and bushing at end. Plenum rated cable neatly organized and supported by “J” hooks or other approved means is acceptable wiring method above accessible ceilings except where conduit is specified.

B. Where exposed or above hard ceilings, wiring shall be in conduit.

C. All wiring on the exterior of the building shall be in conduit.

D. Conduit and wiring shall be concealed in finished areas of the building.

E. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the FACU and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

F. Signaling Line Circuits (SLC’s, also called addressable loops) must be NFPA Style 6 (Class A) with no "T" taps. Each must have a minimum of 20% spare addresses, for future use. Individual loops are permitted to cover more than 1 floor of a building.

G. To minimize wiring fault impact, isolation modules shall be provided as follows. If ceiling height ≤10 feet, isolator base type initiating devices are permitted to be used:
   1. In or immediately adjacent to the FACU, at each end of the addressable loop. These two isolators must be in the same room as the FACU and within 15 feet.
   2. After each 25 initiating devices and control points on the addressable loop, or a lesser number where recommended by the manufacturer. (Check instructions.)
   3. Near the point each addressable circuit extends outside the building walls
   4. For loops covering more than one floor, install isolator at terminal cabinet on each floor (with additional isolator[s] on any floor with over 25 addresses).
   5. Each isolation module must be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling), and shown on as-built drawings

H. All conduits that penetrate outside walls from air conditioned space must have internal sealing (duct-seal), to prevent condensation from infiltrating humid air.

I. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices will not be permitted. Permanent wire markers shall be used to identify all connections at the FACU and other control equipment, at power supplies, and in terminal cabinets.

J. In multistory buildings, all circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

K. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACU. Acceptable cables have capacitance of 30pf/ft. maximum between conductors. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.

1. EXCEPTION #1: Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable.
2. EXCEPTION #2: In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Electrical Identification."

B. All junction boxes shall be painted red prior to pulling the wire. Those installed in finished areas are permitted to be painted outside to match the finish color

C. Install instructions frame in a location visible from the FACU.

D. Paint power-supply disconnect switch red and label "FIRE ALARM."

E. Fire Alarm Wiring: All addressable system wiring shall be color coded in accordance with following scheme, which must be maintained throughout system, without color change in any run:

1. Addressable Loop Controller Circuits: Cable per spec, with Red Jacket and Red(+) and Black(-) Conductors
2. One-way Voice/Alarm and Two-way (Fireman’s Telephone): Wire per 2.8 of "FDAS”
3. The following circuits use THHN / THWN conductors, of the size and color indicated:
    a. Alarm Notification Appliance Circuits: AWG 14, Blue(+) and Black(-) conductors
    b. AHU Shutdown, Elevator Capture, other control functions: These are now done by addressable control relays on the loop. The relays may require separate power circuits, in which case use AWG 14 conductors, with Yellow (+) and Brown (-) color code.
    c. Circuits that power door magnets from the FACU or SNAC panels: AWG 14, Orange.
    d. Circuits from ZAM's to monitored initiating devices: AWG 16 or 14, Violet (+), Grey (-)

3.4 GROUNDING

A. Ground cable shields and equipment according to system manufacturer's written instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements in Division 26 Section "Grounding."

D. Ground equipment and conductor and cable shields. For audio circuits, minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and

other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

3.5 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, adjusting, and maintaining equipment and schedules. Provide a minimum of 8 hours' training.

3.7 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to three requested visits to Project site for this purpose.

B. Programming, Testing, and Certification

1. All connections to the FACU and the system's programming shall be done only by the manufacturer, or by an authorized distributor that stocks a full compliment of spare parts for the system. The technicians who do this are required to be trained and individually certified by the manufacturer, for the FACU model/series being installed. This training and certification must have occurred within the most recent 24 months. Copies of the certifications must be part of the Shop Drawing submittal to the engineer, prior to installation. The submittal cannot be approved without this info.
2. When programming the system, activate the automatic drift compensation feature for all spot-type smoke detectors. Whether or not to activate the alarm verification feature for such detectors is to be determined by the design engineer/owner's rep. In the absence of clear guidance on the latter, do not activate alarm verification.
3. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the design engineer/owner's rep.
4. Print a complete System Status and Programming Report, after the above steps have been done. This must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector.
5. The manufacturer or authorized distributor must 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation must be part of the "System Status and Programming Report"

6. Upon completion of the installation and its programming, the fire alarm technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc. The engineer must be notified in advance of these 100% tests, to permit witnessing them if desired.

7. The contractor must fill out and submit the following documentation to the owner, through the engineer, prior to the AHJ's system acceptance inspection:

   a. The NFPA 72-1999, Figure 1-6.2.1, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and also to certify that: (a.) It was done per Code, and (b.) The Code-required 100% test was performed. If a representative of the AHJ, owner, or engineer witnesses the tests, they sign the last line of the form to signify that fact only (annotating the form as needed).

   b. The System Status and Programming Report must be generated on the day of the system acceptance inspection.

   c. After completion of the 100% system test and submission of documentation per the contractor is to request the engineer to set up an inspection. The system must operate for at least two days prior to this inspection.

   d. The fire alarm system will be inspected, with portions of it functionally tested. This will normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off-premises supervising station. Operation of any smoke removal system will be checked as instructed by the AHJ. This statistical (sampling) inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. The contractor normally provides two-way radios, ladders, and other materials needed for testing the system, included a suitable smoke source.

3.8 Documentation, Owner Training, and Spare Parts:

A. In addition to the Shop Drawing submittal, provide two bound copies of the following technical information, for transmittal to the owner: (1) As-Built wiring diagram showing all loop numbers and device addresses, plus terminal numbers where they connect to control equipment, (2) Manufacturer's detailed maintenance requirements, (3) Technical literature on all control equipment, isolation modules, power supplies, alarm/supervisory signal initiating devices, alarm notification appliances, relays, etc, (4) The as-built "calculations" sheet..

B. Complete configuration data (site-specific programming) for the system must be stored on electronic media and archived by the fire alarm system manufacturer or authorized distributor. A diskette or CD copy of this data shall be submitted to the engineer for transmission to the owner on the day the system is commissioned.

C. The manufacturer, or authorized distributor, must maintain software version (VER) records on the system installed. The system software shall be upgraded free of any charge if a new VER is released during the warranty period. For new VER to correct operating problems, free upgrade shall apply during the entire life of the system.

D. Basic operating instructions shall be framed and permanently mounted at the FACU. (If the owner concurs, they may instead be affixed to the inside of the FACU's door.) In addition, the NFPA 72 "Record of Completion" (see 7.7) must either be kept at/in the FACU, or its location shall be permanently indicated there by engraved label.

E. Provide an engraved label inside the FACU identifying its 120vac power source, as follows: Panelboard location, panelboard identification, and branch circuit number.

F. The manufacturer's authorized representative must instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 2 hours on-site time will be allocated for this purpose and, for those facilities operating on a 24-hour basis (prisons, hospitals, etc.), one additional hour of instruction will be individually provided for the 2nd and 3rd shift. Two copies of a written, bound summary will be provided, for future reference.

TABLE I -- APPLICATIONS MATRIX FOR SELECTING DETECTION DEVICES

SMOKE/FIRE DETECTOR APPLICATION	ACCEPTABLE DETECTOR TYPES*			
	ION	PHOTO	IR/UV FLAME	HEAT
Atriums/Auditoriums		B**		
Corridors – Any Occupancy		X		
Office Areas	X	X		
Cable Rooms (PVC)		X		
Elevator Equipment Rooms	X			
Furnace/Boiler Rooms				X
Gymnasiums		B**		
Laboratories (Chemical)			X	X
Linen Rooms		X		
Mech/Elect. Equipment Rooms	X	X		X
Motor-Generator Rooms			X	X
Attics (Non-Conditioned Environment)				X
Loading Docks			X	X
Non-Conditioned or Hostile Environment			X	X
Storage (Conditioned Environment Only)	X	X		
Duct Smoke Detectors		X		

****** "B" symbol indicates projected beam (linear beam) type smoke detector with separate transmitter and receiver, or with transceiver and prism reflector.

Spaces which may be exposed to vehicle exhaust, fumes from nearby cooking, fireplaces, etc., high/low temperatures or high humidity (including dishwashing, laundry) are generally unsuitable for the use of smoke detectors. Heat detectors should include the rate-of-rise feature unless installed where temperatures may rise more than 15°F/minute from space heaters, vehicle exhaust stacks, furnaces, or following outside door closure.

END OF SECTION 283111

SUBMITTAL DATA PREPARED
FOR:

SELF HELP BEACON POINT

LEGAL AID

1440 ROCK QUARRY RD.
RALEIGH, NC 27610

PREPARED BY:
J & D SPRINKLER CO, INC.
315 W. MAIN STREET
CLAYTON, NC 27520

PH: (919)-553-2356 FAX: (919)-359-0622

TABLE OF CONTENTS

SPRINKLER HEADS

Victaulic® FireLock™ Series FL-QR
Standard Coverage, Quick Response
Upright, Pendent and Recessed Pendent Sprinklers
K2.8 (4.0), K4.2 (6.1), K5.6 (8.1), K8.0 (11.5)

41.01




1.0 PRODUCT DESCRIPTION

QUICK RESPONSE UPRIGHT SPRINKLERS				
SIN	**V2815**	**V4215**	**V2704**	**V3402**
ORIENTATION	UPRIGHT	UPRIGHT	UPRIGHT	UPRIGHT
K-FACTOR[1]	2.8 Imp./4.0 S.I.	4.2 Imp./6.1 S.I.	5.6 Imp./8.1 S.I.	8.0 Imp./11.5 S.I.
CONNECTION	½" NPT/15mm BSPT	½" NPT/15mm BSPT	½" NPT/15mm BSPT/IGS	¾" NPT/20mm BSPT/IGS
MAX. WORKING PRESSURE	175 psi/1200 kPa	175 psi/1200 kPa	175 psi/1200 kPa cULus 250 psi /1725 kPa	175 psi/1200 kPa
GLOBE RE-DESIGNATION	GL2815	GL4215	–	–
GLOBE EQUIVALENT	–	–	GL5615	GL8118

QUICK RESPONSE PENDENT SPRINKLERS				
SIN	**V2801**	**V4201**	**V2708**	**V3406**
ORIENTATION	PENDENT	PENDENT	PENDENT	PENDENT
K-FACTOR[1]	2.8 Imp./4.0 S.I.	4.2 Imp./6.1 S.I.	5.6 Imp./8.1 S.I.	8.0 Imp./11.5 S.I.
CONNECTION	½" NPT/15mm BSPT	½" NPT/15mm BSPT	½" NPT/15mm BSPT/IGS	¾" NPT/20mm BSPT/IGS
MAX. WORKING PRESSURE	175 psi /1200 kPa	175 psi /1200 kPa	175 psi /1200 kPa cULus 250 psi/1725 kPa	175 psi/1200 kPa
GLOBE RE-DESIGNATION	GL2801	GL4201	–	–
GLOBE EQUIVALENT	–	–	GL5601	GL8101

QUICK RESPONSE RECESSED PENDENT SPRINKLERS				
SIN	**V2801**	**V4201**	**V2708**	**V3406**
ORIENTATION	PENDENT	PENDENT	PENDENT	PENDENT
K-FACTOR[1]	2.8 Imp./4.0 S.I.	4.2 Imp./6.1 S.I.	5.6 Imp./8.1 S.I.	8.0 Imp./11.5 S.I.
CONNECTION	½" NPT/15mm BSPT	½" NPT/15mm BSPT	½" NPT/15mm BSPT/IGS	¾" NPT/20mm BSPT/IGS
MAX. WORKING PRESSURE	175 psi/1200 kPa	175 psi/1200 kPa	175 psi/1200 kPa cULus 250 psi/1725 kPa	175 psi/1200 kPa
ESCUTCHEON	Recessed	Recessed	Recessed	Recessed
GLOBE RE-DESIGNATION	GL2801	GL4201	–	–
GLOBE EQUIVALENT	–	–	GL5601	GL8101

AVAILABLE GUARDS/SHIELDS				
SPRINKLER	**V28**	**V42**	**V27**	**V34**
Upright			■	■
Pendent			■	■

AVAILABLE WRENCHES							
SPRINKLER	**V56-2 Recessed**	**V56 Open End**	**V27-2 Recessed**	**V27 Open End**	**V34-2 Recessed**	**V34 Open End**	**3/16 Hex-Bit**
V2815 and V4215		■					
V2707 and V2704				■			■
V3402						■	■
V2801, and V4201	■	■					
V2706 and V2708			■	■			■
V3406					■	■	■

Factory Hydrostatic Test: 100% @ 500 psi/3447 kPa/34 bar

Min. Operating Pressure: UL/FM: 7 psi/48 kPa/.5 bar
VdS: 5 psi/35 kPa/.35 bar (Upright only)

Temperature Rating: See tables in section 2.0

[1] For K-Factor when pressure is measured in bar, multiply S.I. units by 10.0.

ALWAYS REFER TO ANY NOTIFICATIONS AT THE END OF THIS DOCUMENT REGARDING PRODUCT INSTALLATION, MAINTENANCE OR SUPPORT.

 © 2022 Victaulic Company. All rights reserved.

2.0 CERTIFICATION/LISTINGS

UPRIGHT APPROVALS/LISTINGS				
SIN	**V2815**	**V4215**	**V2704**	**V3402**
Nominal K Factor Imperial	2.8	4.2	5.6	8.0
Nominal K Factor S.I.[2]	4.0	6.1	8.1	11.5
Orientation	UPRIGHT	UPRIGHT	UPRIGHT	UPRIGHT
	Approved Temperature Ratings F°/C°			
cULus	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C
FM	–	–	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C
LPCB	–	–	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C
CE, UKCA	–	–	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C
VdS	–	–	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C
CCC K-ZSTZ	–	–	155°F/68°C 175°F/79°C 286°F/141°C	155°F/68°C 286°F/141°C

[2] For K-Factor when pressure is measured in Bar, multiply S.I. units by 10.

PENDENT APPROVALS/LISTINGS				
SIN	**V2801**	**V4201**	**V2708**	**V3406**
Nominal K Factor Imperial	2.8	4.2	5.6	8.0
Nominal K Factor S.I.[2]	4.0	6.1	8.1	11.5
Orientation	PENDENT	PENDENT	PENDENT	PENDENT
Escutcheon	Flush/Extended	Flush/Extended	Flush/Extended	Flush/Extended
	Approved Temperature Ratings F°/C°			
cULus	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C
FM	–	–	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C
CCC K-ZSTX	–	–	155°F/68°C 200°F/93°C 286°F/141°C	155°F/68°C 286°F/141°C

[2] For K-Factor when pressure is measured in Bar, multiply S.I. units by 10.

NOTES

- Listings and approval as of printing.
- Where cULus Listed, Polyester and VC-250 Coatings Listed as Corrosion Resistant (V3402 with VC-250 Only)
- Where FM Approved, VC-250 Coating Approved as Corrosion Resistant
- New York City Acceptance - All UL Listed and/or FM Approved sprinklers acceptable to NYC per section 28-113 of the Administrative Code and the OTCR Rule.

 © 2022 Victaulic Company. All rights reserved.

2.0 CERTIFICATION/LISTINGS (CONTINUED)

RECESSED PENDENT APPROVALS/LISTINGS				
SIN	**V2801**	**V4201**	**V2708**	**V3406**
Nominal K Factor Imperial	2.8	4.2	5.6	8.0
Nominal K Factor S.I.[2]	4.0	6.1	8.1	11.5
Orientation	PENDENT	PENDENT	PENDENT	PENDENT
Escutcheon	Recessed	Recessed	Recessed	Recessed
Approved Temperature Ratings F°/C°				
cULus	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C 286°F/141°C
FM WITH ½" ADJUSTMENT ESCUTCHEON ONLY	–	–	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C	135°F/57°C 155°F/68°C 175°F/79°C 200°F/93°C
CCC K-ZSTX	–	–	155°F/68°C 200°F/93°C 286°F/141°C	155°F/68°C 286°F/141°C

[2] For K-Factor when pressure is measured in Bar, multiply S.I. units by 10.

NOTES

- Listings and approval as of printing.
- Where cULus Listed, Polyester and VC-250 Coatings Listed as Corrosion Resistant (V3402 with VC-250 Only)
- Where FM Approved, VC-250 Coating Approved as Corrosion Resistant
- New York City Acceptance - All UL Listed and/or FM Approved sprinklers acceptable to NYC per section 28-113 of the Administrative Code and the OTCR Rule.

 © 2022 Victaulic Company. All rights reserved.

3.0 SPECIFICATIONS – MATERIAL

Deflector: Bronze

Bulb Nominal Diameter: 3.0mm

Load Screw: Bronze

Pip Cap: Bronze

Spring Seal: PTFE coated Beryllium nickel alloy

Frame: Brass

Lodgement Spring: Stainless steel

Installation Wrench: Ductile iron

Sprinkler Frame Finishes:

- Plain brass
- Chrome plated
- White polyester painted[3, 4]
- Flat black polyester painted[3, 4]
- Custom polyester painted[3, 4]
- VC-250[5]

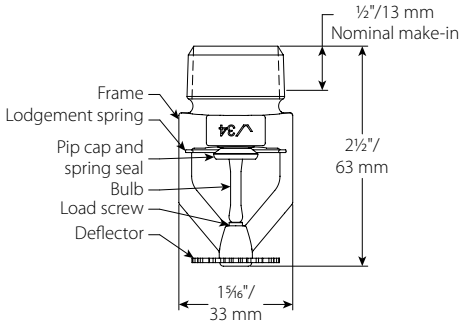
[3] Not available on the Intermediate Level Style Pendent.

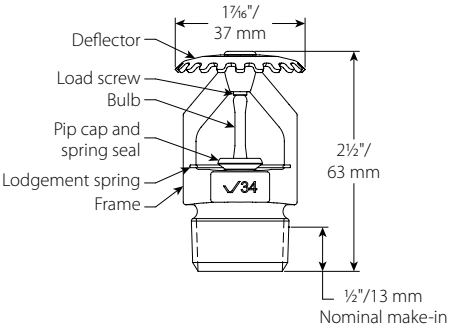
[4] UL Listed for corrosion resistance.

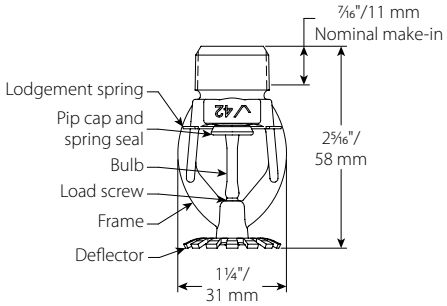
[5] UL Listed and FM Approved for corrosion resistance.

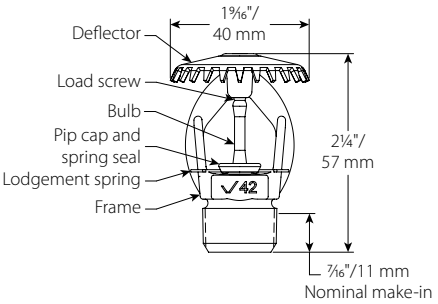
NOTE

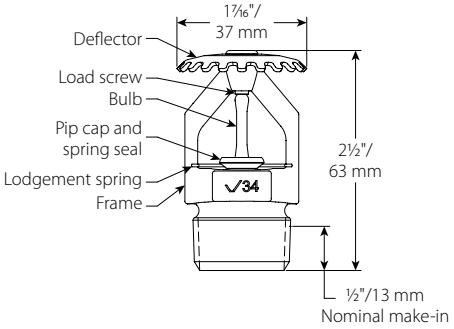
- For cabinets and other accessories refer to separate sheet.

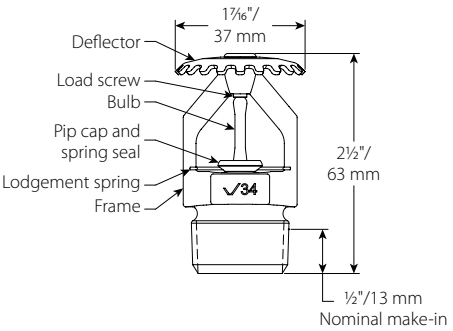






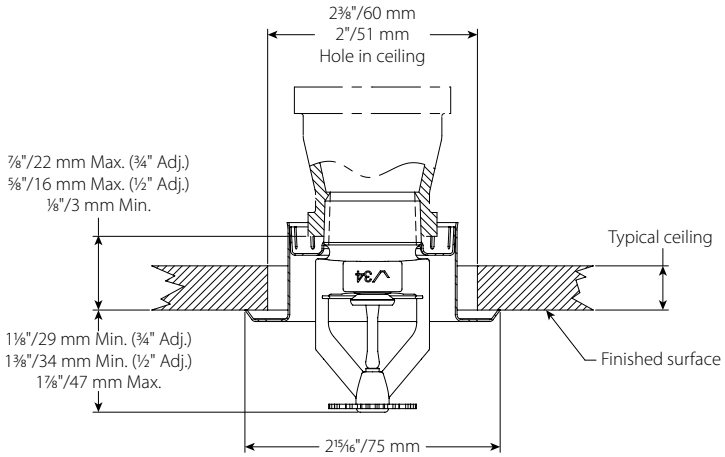


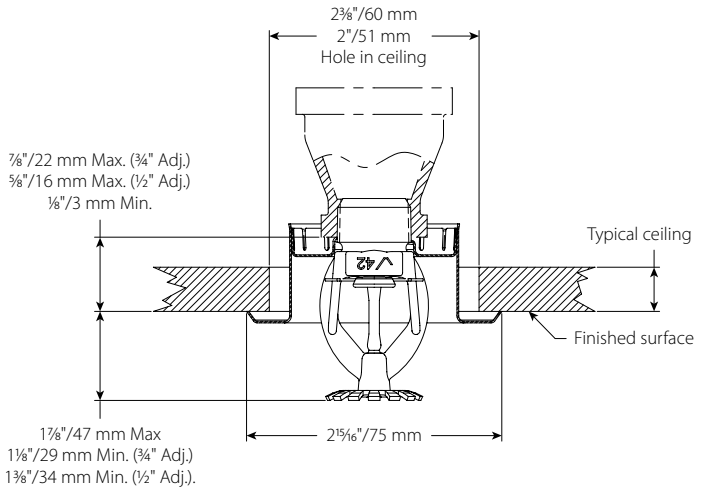


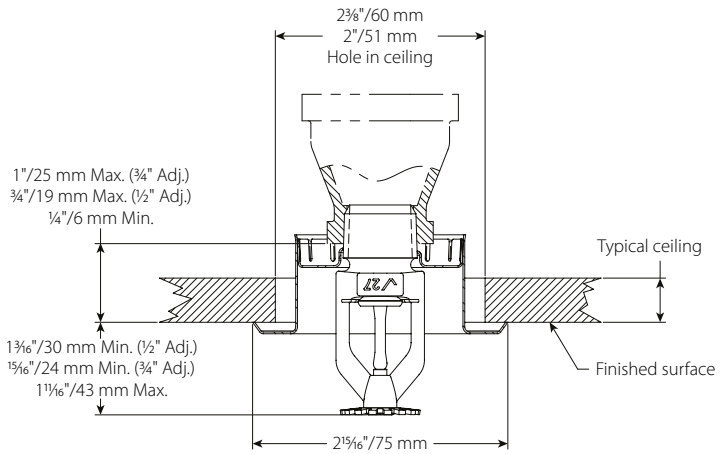


 © 2022 Victaulic Company. All rights reserved.

4.0 DIMENSIONS







 © 2022 Victaulic Company. All rights reserved.

5.0 PERFORMANCE

Sprinkler is to be installed and designed as per NFPA, FM Datasheets, or any local standards.

6.0 NOTIFICATIONS

⚠ WARNING

- **Read and understand all instructions before attempting to install any Victaulic products.**
- **Always verify that the piping system has been completely depressurized and drained immediately prior to installation, removal, adjustment, or maintenance of any Victaulic products.**
- **Wear safety glasses, hardhat, and foot protection.**

Failure to follow these instructions could result in death or serious personal injury and property damage.

- **These products shall be used only in fire protection systems that are designed and installed in accordance with current, applicable National Fire Protection Association (NFPA 13, 13D, 13R, etc.) standards, or equivalent standards, and in accordance with applicable building and fire codes. These standards and codes contain important information regarding protection of systems from freezing temperatures, corrosion, mechanical damage, etc.**
- **The installer shall understand the use of this product and why it was specified for the particular application.**
- **The installer shall understand common industry safety standards and potential consequences of improper product installation.**
- **It is the system designer's responsibility to verify suitability of materials for use with the intended fluid media within the piping system and external environment.**
- **The material specifier shall evaluate the effect of chemical composition, pH level, operating temperature, chloride level, oxygen level, and flow rate on materials to confirm system life will be acceptable for the intended service.**

Failure to follow installation requirements and local and national codes and standards could compromise system integrity or cause system failure, resulting in death or serious personal injury and property damage.

7.0 REFERENCE MATERIALS

Ratings: All glass bulbs are rated for temperatures from -67°F/-55°C to those shown in the table below.

I-40: Victaulic FireLock™ Automatic Sprinklers Installation and Maintenance Instructions

I-V9: Style V9 Victaulic FireLock™ IGS™ Installation-Ready™ Sprinkler Coupling Installation Instructions

User Responsibility for Product Selection and Suitability
Each user bears final responsibility for making a determination as to the suitability of Victaulic products for a particular end-use application, in accordance with industry standards and project specifications, as well as Victaulic performance, maintenance, safety, and warning instructions. Nothing in this or any other document, nor any verbal recommendation, advice, or opinion from any Victaulic employee, shall be deemed to alter, vary, supersede, or waive any provision of Victaulic Company's standard conditions of sale, installation guide, or this disclaimer.

Intellectual Property Rights
No statement contained herein concerning a possible or suggested use of any material, product, service, or design is intended, or should be constructed, to grant any license under any patent or other intellectual property right of Victaulic or any of its subsidiaries or affiliates covering such use or design, or as a recommendation for the use of such material, product, service, or design in the infringement of any patent or other intellectual property right. The terms "Patented" or "Patent Pending" refer to design or utility patents or patent applications for articles and/or methods of use in the United States and/or other countries.

Note
This product shall be manufactured by Victaulic or to Victaulic specifications. All products to be installed in accordance with current Victaulic installation/assembly instructions. Victaulic reserves the right to change product specifications, designs and standard equipment without notice and without incurring obligations.

Installation
Reference should always be made to the Victaulic installation handbook or installation instructions of the product you are installing. Handbooks are included with each shipment of Victaulic products, providing complete installation and assembly data, and are available in PDF format on our website at www.victaulic.com.

Warranty
Refer to the Warranty section of the current Price List or contact Victaulic for details.

Trademarks
Victaulic and all other Victaulic marks are the trademarks or registered trademarks of Victaulic Company, and/or its affiliated entities, in the U.S. and/or other countries.

41.01 16343 Rev D Updated 07/2022 © 2022 Victaulic Company. All rights reserved.

PIPE

SCHEDULE 10 & 40

Always ready to protect your most valuable assets.

As the leading supplier of steel sprinkler pipe, we understand that there are no second chances in fire suppression. You need products of enduring quality and exceptional strength–plus reliable service. You need Bull Moose.

Bull Moose Fire Sprinkler Pipe Product Information

	Nominal Pipe Size (Inches)	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"	6"	8"
SCHEDULE 10	O.D. (in)	1.315	1.660	1.900	2.375	2.875	3.500	4.500	6.625	8.625
	I.D. (in)	1.097	1.442	1.682	2.157	2.635	3.260	4.260	6.357	8.249
	Empty Weight (lb/ft)	1.410	1.810	2.090	2.640	3.530	4.340	5.620	9.290	16.940
	Water Filled Weight (lb/ft)	1.820	2.518	3.053	4.223	5.893	7.957	11.796	23.038	40.086
	C.R.R.	15.27	9.91	7.76	6.27	4.92	3.54	2.50	1.158	1.805
	Pieces per Lift	91	61	61	37	30	19	19	10	7
	Lift Weight (lbs) 21' lengths	2,695	2,319	2,677	2,051	2,224	1,732	2,242	1,951	2,490
	Lift Weight (lbs) 24' lengths	3,079	2,650	3,060	2,344	2,542	1,979	2,563	2,230	2,848
	Lift Weight (lbs) 25' lengths	3,208	2,760	3,187	2,442	2,648	2,062	2,670		

	NPS (In.)	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"
SCHEDULE 40		1.315	1.660	1.900	2.375	2.875	3.500	4.500
		1.049	1.380	1.610	2.067	2.469	3.068	4.026
		1.680	2.270	2.720	3.660	5.800	7.580	10.800
		2.055	2.918	3.602	5.114	7.875	10.783	16.316
		1.00	1.00	1.00	1.00	1.00	1.00	1.00
		70	51	44	30	30	19	19
		2,470	2,431	2,513	2,306	3,654	3,024	4,309
		2,822	2,778	2,872	2,635	4,176	3,456	4,925
		2,940	2,894	2,992	2,745	4,350	3,601	5,130

SCHEDULE 10 & 40 ADVANTAGES:

- UL listed (US & Canada) and FM approved
- ASTM A135 and A795 Type E, Grade A Certified
- Complies with NFPA-13, 13R and 14
- Industry-leading hydraulic characteristics
- CRR of 1.0 and greater
- All pipe NDT weld tested

OTHER BENEFITS/SERVICES:

- We have the most stocking locations in the industry, for best delivery and availability
- Plain end or roll groove
- Eddy Guard II™ bacterial-resistant internal coating
- Custom length options
- Hot dipped galvanization
- Reddi-Pipe® red or black pipe eliminates field painting
- Compatible for use in wet, dry, preaction and deluge sprinkler systems
- The only maker with EPDs (to help earn LEED points).

Exclusive maker of Reddi-Pipe®
RED OR BLACK PAINTED PIPE.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

c UL us LISTED

FM APPROVED

NFPA

AFSA American Fire Sprinkler Association

NFSA The Voice of the Fire Sprinkler Industry

BULL MOOSE TUBE

800.325.4467
sales@BullMooseIndustries.com
BullMooseTube.com

Victaulic® VicFlex™ Sprinkler Fittings
Series AH2 and AH2-CC Braided Flexible Hoses

10.85

Series AH2

Series AH2-CC

1.0 PRODUCT DESCRIPTION

Available Sizes by Component

- **Series AH2 1"/DN25 Nominal ID Braided Hose:** 31, 36, 48, 60, 72"/790, 915, 1220, 1525, 1830 mm.
  Note: length includes adapter nipple and 5.75"/140 mm straight reducer.
- **Series AH2-CC 1"/DN25 Nominal ID Braided Hose:** 31, 36, 48, 60, 72"/790, 915, 1220, 1525, 1830 mm.
  Note: length includes captured coupling and 5.75"/140 mm straight reducer.
- **Sprinkler Reducers:**
  - **Sprinkler Connections:** ½ and ¾"/15 and 20 mm
  - **Straight Lengths:** 5.75, 9, 13"/140, 230, 330 mm
  - **90° Elbows:**
    - Short (typically used with concealed sprinklers)
    - Long (typically used with recessed pendent sprinklers)
    - Low Profile Short (for use with Style AB5, AB11, AB12, ABBA and ABMM Bracket)
    - Low Profile Long (for use with Style AB5, AB11, AB12, ABBA and ABMM Bracket)
- **Inlet Connections:**
  - 1"/25 mm Grooved IGS
  - 1"/25 mm NPT or BSPT adapter nipples for attaching to pipe and fittings outlined in NFPA standards.
  - ¾"/20 mm NPT or BSPT adapter nipples available for VdS.
  - 1 ¼"/ 32 mm BSPT adapter nipples available for LPCB.

ALWAYS REFER TO ANY NOTIFICATIONS AT THE END OF THIS DOCUMENT REGARDING PRODUCT INSTALLATION, MAINTENANCE OR SUPPORT.

System No.		Location	
Submitted By		Date	

Spec Section		Paragraph	
Approved		Date	

© 2019 Victaulic Company. All rights reserved.

1.0 PRODUCT DESCRIPTION (Continued)

- **Brackets:**
  - Style AB1 for suspended and hard-lid ceilings and sidewalls, allows installation before most ceiling tiles in place
  - Style AB2 for suspended and hard-lid ceilings and sidewalls, allows for vertical sprinkler adjustment, and installation before most ceiling tiles in place
  - Style AB3 for surface mount applications, wood, metal and block walls, or ceilings
  - Style AB4 for hard-lid ceilings with hat furring channel grid systems, allows for vertical sprinkler adjustment
  - Style AB5 for hard-lid ceilings and sidewalls, allows for vertical sprinkler adjustment
  - Style AB7 for suspended and hard-lid ceilings
  - Style AB7 Adjustable for suspended and hard-lid ceilings
  - Style AB8 for hard-lid ceilings with CD 60/27 profile metal studs (regionally available)
  - Style AB9 for hard-lid ceilings with hat furring channel grid systems
  - Style AB10 for Armstrong® TechZone™ ceilings
  - Style AB11 for lay-in panel suspended t-grid ceilings or drywall suspended t-grid ceilings, allows for low profile installations (use only with 90° low profile elbows)
  - Style AB12 for suspended and hard-lid ceilings, allows for vertical sprinkler adjustment, and allows for low profile installation down to 4"/100mm.
  - Style ABBA bracket for suspended, exposed, and hard-lid ceilings
  - Style ABMM bracket for surface mount and stand off-mount applications, wood, metal and block walls, or ceilings and hard-lid ceilings

Maximum Working Temperature

- 225°F/107°C

Maximum Working Pressure

- 200 psi/1375 kPa (FM Approval)
- 175 psi/1206 kPa (cULus Listed)
- 1600 kPa/232 psi (VdS/LPCB Approved)
- 1.4 MPa (CCCf Approved)

Connections

- To adapter nipple (inlet) via
  - 1"/25.4 mm Grooved IGS
  - 1"/25.4 mm NPT or BSPT male thread
  - ¾"/20 mm BSPT male thread (VdS only)
  - 1 ¼"/32 mm BSPT male thread (LPCB only)
- To sprinkler head (outlet) via ½" or ¾"/15 mm or 20 mm

Minimum Bend Radius

- 7"/178 mm (FM/CCCf Approval)
- 2"/51 mm (cULus Listed)
- 3"/76.2 mm (VdS/LPCB Approved)

Maximum Allowable Sprinkler K-Factors

- FM (½"/15 mm reducer) K5.6/8,1 (S.I.), (¾"/20 mm reducer) K14.0/20,2 (S.I.)
- cULus (½"/15 mm reducer) K8.0/11,5 (S.I.), (¾"/20 mm reducer) K14.0/20,2 (S.I.)
- VdS/LPCB (½"/15 mm reducer) K5.6/8,1 (S.I.), (¾"/20 mm reducer) K8.0/11,5 (S.I.)

 © 2019 Victaulic Company. All rights reserved.

2.0 CERTIFICATION/LISTINGS

NOTE

- The *VicFlex* Series AH2 Hose has been tested and evaluated by Spears® for acceptable use with Spears® CPVC Products and is therefore covered under the Spears® FlameGaurd® Installer Protection Plan.

3.0 SPECIFICATIONS – MATERIAL

Series AH2

- **Flexible Hose:** 300-series Stainless Steel
- **Collar/Weld Fitting:** 300-series Stainless Steel
- **Gasket Seal:** Victaulic EPDM
- **Isolation Ring:** Nylon
- **Nut and Nipple:** Carbon Steel, Zinc Plated
- **Reducer (½"/15 mm or ¾"/20 mm):** Carbon Steel, Zinc-Plated
- **Low Profile Elbows:** Ductile Iron, Zinc-Plated

Brackets: Carbon Steel, Zinc-Plated

Series AH2-CC

- **Flexible Hose:** 300-series Stainless Steel
- **Collar/Weld Fitting:** 300-series Stainless Steel
- **Gasket Seal:** Victaulic EPDM
- **Isolation Ring:** Nylon
- **Coupling Retainer Ring:** Polyethelene
- **Nut and Nipple:** Carbon Steel, Zinc Plated
- **Reducer (½"/15 mm or ¾"/20 mm):** Carbon Steel, Zinc-Plated
- **Housing:** Ductile iron conforming to ASTM A 536, Grade 65-45-12. Ductile iron conforming to ASTM A 395, Grade 65-45-15, is available upon special request.

  Coupling Housing Coating:

  - Orange enamel (North America, Asia Pacific).
  - Red enamel (Europe).
  - Hot dipped galvanized.

  Gasket:[1]

  - **Grade "E" EPDM (Type A)**
    FireLock EZ products have been Listed by Underwriters Laboratories Inc., Underwriters Laboratories of Canada Limited, and Approved by Factory Mutual Research for wet and dry (oil free air) sprinkler services within the rated working pressure.

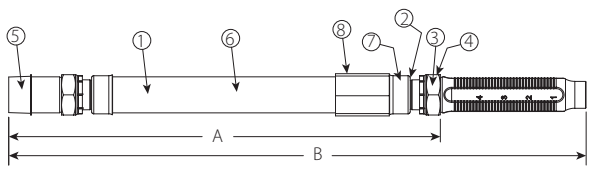
  [1] Services listed are General Service Guidelines only. It should be noted that there are services for which these gaskets are not compatible. Reference should always be made to the latest Victaulic Gasket Selection Guide for specific gasket service guidelines and for a listing of services which are not compatible.

- **Bolts/Nut:** Zinc electroplated carbon steel, trackhead meeting the physical and chemical requirements of ASTM A 449 and physical requirements of ASTM A 183.
- **Linkage:** CrMo Alloy Steel zinc electroplated per ASTM B633 Zn/Fe 5, Type III Finish

 © 2019 Victaulic Company. All rights reserved.

4.0 DIMENSIONS

Product Details - Series AH2 Braided Hose

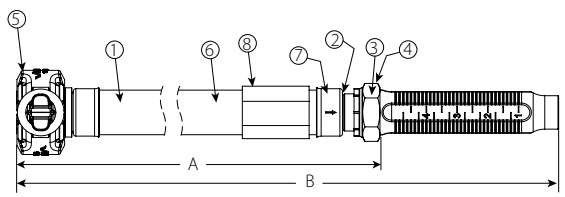


Item	Description
1	Flexible Hose
2	Isolation Ring
3	Gasket
4	Nut
5	Adapter Nipple
6	Braid
7	Collar/Weld Fitting
8	Sleeve

Hose Length Dimensions

Hose Length inches mm	A inches mm	B inches mm
31/790	25.3/641	31/790
36/915	31.3/794	36/915
48/1219	42.3/1073	48/1220
60/1525	54.3/1378	60/1525
72/1830	66.3/1683	72/1830

Series AH2-CC Braided Hose



Item	Description
1	Flexible Hose
2	Isolation Ring
3	Gasket
4	Nut
5	Captured Coupling
6	Braid
7	Collar/Weld Fitting
8	Sleeve

Hose Length inches mm	A inches mm	B inches mm
31/790	24.5/622	29.8/757
36/915	29.5/749	34.8/884
48/1219	41.5/1054	46.8/1189
60/1525	53.5/1359	58.8/1494
72/1830	65.5/1664	70.8/1798

 © 2019 Victaulic Company. All rights reserved.

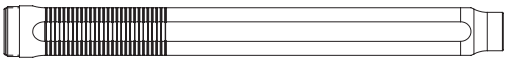
4.0 DIMENSIONS (Continued)

Standard Reducer

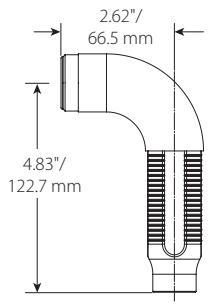
5.75"/140 mm straight reducer

Optional Reducers

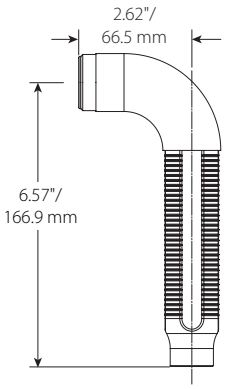
9.0"/229 mm straight reducer



13.0"/330 mm straight reducer



Short 90° elbow reducer

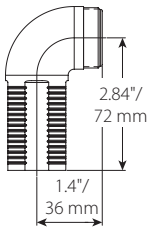


Long 90° elbow reducer

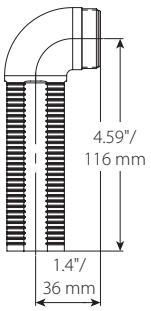
NOTE

- The Short 90° elbow reducer is typically used with concealed sprinklers while the longer 90 elbow is typically used in the installation of recessed pendent sprinklers.
- FM/VdS Approved only.

Low Profile



Short 90° elbow reducer



Long 90° elbow reducer

NOTE

- Style AB11: When low profiles elbows are used with the Style AB11 bracket, the Low Profile Short Elbow is typically used with concealed sprinklers while the Low Profile Long Elbow is typically used in the installation of recessed pendent sprinklers.

 © 2019 Victaulic Company. All rights reserved.

4.1 DIMENSIONS

VicFlex Brackets

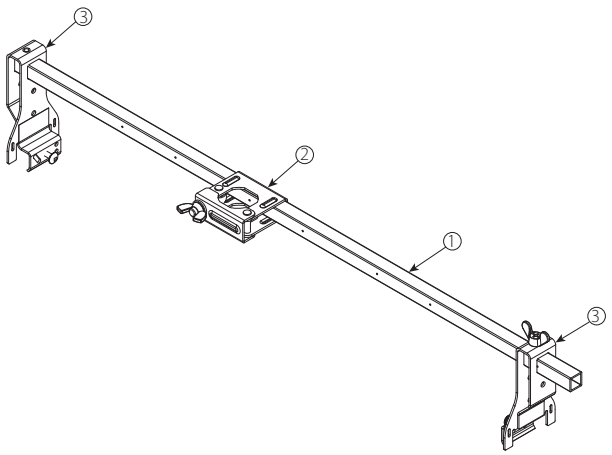
Style AB1

- Suspended Ceilings
- Hard-Lid Ceilings (FM Only)

Item	Description
1	24"/610 mm or 48"/1219 mm Square Bar
2	Patented Center Bracket
3	End Bracket

NOTE

- Both sizes FM/VdS/LPCB Approved, cULus listed



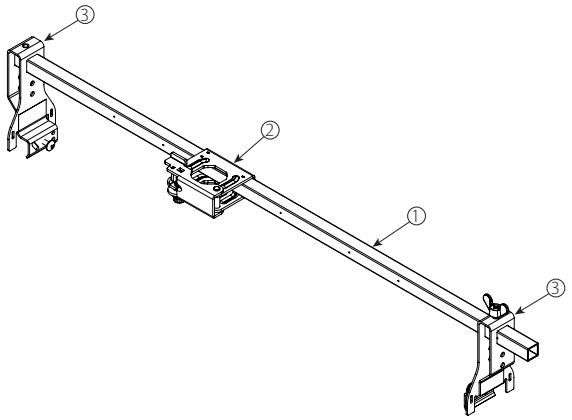
Style AB2

- Suspended Ceilings
- Hard-Lid Ceilings

Item	Description
1	24"/610 mm or 48"/1219 mm Square Bar
2	Patented Vertically Adjustable Center Bracket
3	End Bracket

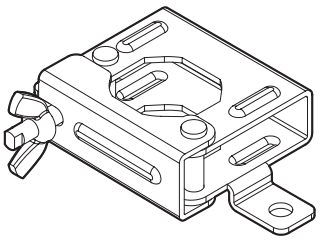
NOTE

- Both sizes FM/VdS/LPCB Approved, cULus listed



Style AB3

- Surface Mount Applications
- FM/LPCB Approved



 © 2019 Victaulic Company. All rights reserved.

4.2 DIMENSIONS

VicFlex Brackets

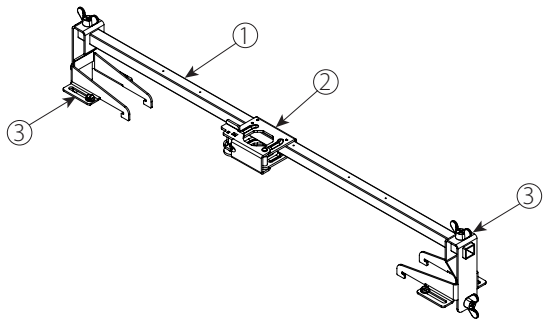
Style AB4

- Hard-Lid Ceilings with Hat furring channel grid system

Item	Description
1	24"/610 mm or 48"/1219 mm Square Bar
2	Patented Vertically Adjustable Center Bracket
3	End Bracket for Hat Furring Channel

NOTE

- Both sizes FM/VdS/LPCB Approved, cULus listed.



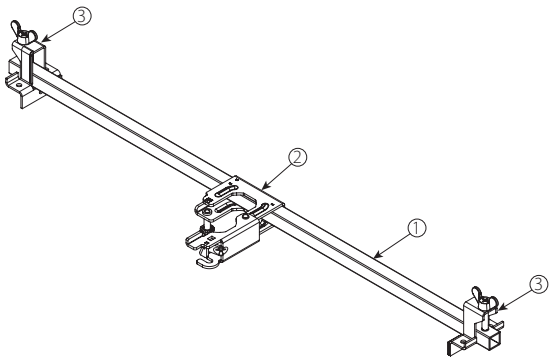
Style AB5

- Hard-Lid Ceilings

Item	Description
1	24"/610 mm or 48"/1219 mm Square Bar
2	Patented Vertically Adjustable Center Bracket
3	End Bracket

NOTE

- Both sizes FM/VdS/LPCB Approved, cULus listed.



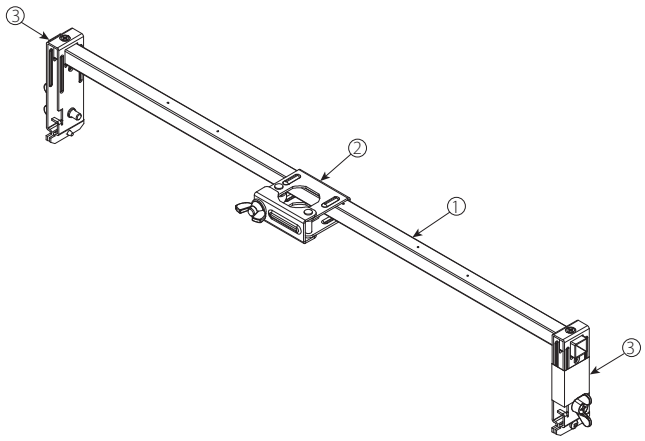
Style AB7

- Suspended Ceilings
- Hard-Lid Ceilings

Item	Description
1	24"/610 mm or 48"/1219 mm Square Bar
2	Patented 1-Bee2® Center Bracket
3	End Bracket

NOTE

- Both sizes FM/VdS/LPCB Approved.



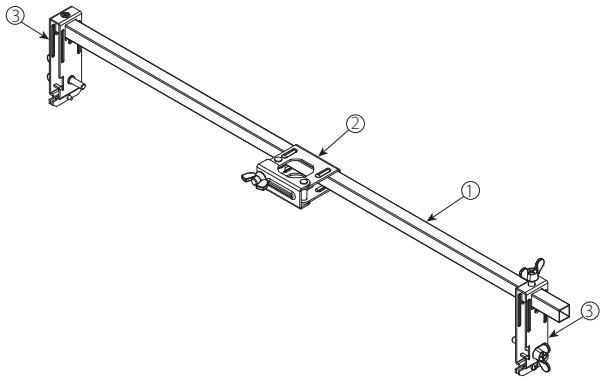
Style AB7 Adjustable

- Suspended Ceilings
- Hard-Lid Ceilings

Item	Description
1	700 mm or 1400 mm Square Bar
2	Patented 1-Bee2® Center Bracket
3	End Bracket (adjustable)

NOTE

- Both sizes FM/VdS/LPCB Approved.



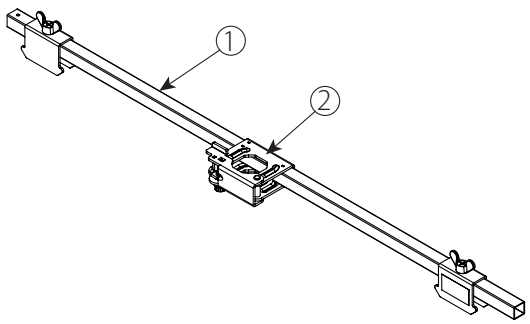
 © 2019 Victaulic Company. All rights reserved.

4.3 DIMENSIONS

VicFlex Brackets

Style AB8

- Hard-Lid Ceilings



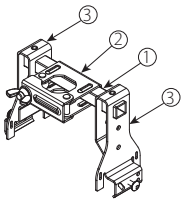
Item	Description
1	700 mm or 1400 mm Square Bar
2	Patented Vertically Adjustable Center Bracket
3	End Bracket

NOTE

- Both sizes FM/VdS/LPCB Approved.

Style AB10

- Suspended ceilings
- Armstrong® TechZone™



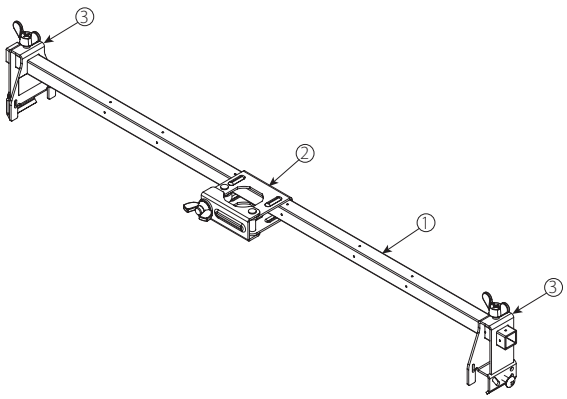
Item	Description
1	6"/152 mm Square Bar
2	Patented 1-Bee2® Center Bracket
3	End Bracket

NOTE

- FM/VdS/LPCB Approved, cULus listed.

Style AB11

- Suspended ceilings
- Hard-Lid ceilings



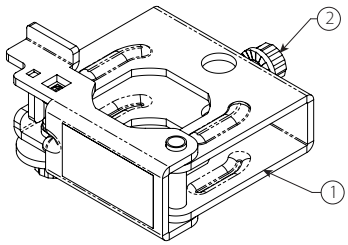
Item	Description
1	24"/610 mm or 48"/1219 mm Square Bar
2	Patented 1-Bee2® Center Bracket
3	End Bracket

NOTE

- FM/VdS Approved, cULus listed.

Style AB12

- Suspended ceilings
- Hard-Lid ceilings



Item	Description
1	Style AB12 Bracket Body
2	#2 Square Drive Set Screw

NOTE

- FM/VdS Approved.

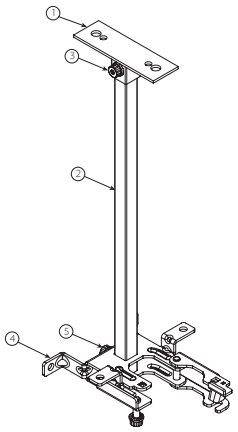
 © 2019 Victaulic Company. All rights reserved.

4.3 DIMENSIONS (CONTINUED)

VicFlex Brackets

Style ABBA

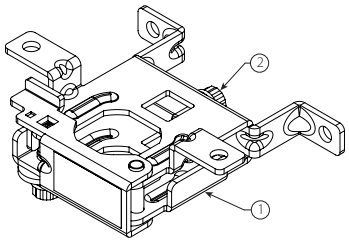
- Floor-above mount
- Cantilever mount
- Temporary mount in exposed ceilings



Item	Description
1	Style ABBA Mounting Plate
2	Style ABBA Square Bar
3	Cap Screw, Serated Flange, M6 x 1 x 20, T25 Torx Drive Recessed
4	Style ABMM Bracket Body
5	Cap Screw, Serated Flange, M6 x 1 x 15.24, T25 Torx Drive Recessed

Style ABMM

- Surface mount
- Stand-off mount



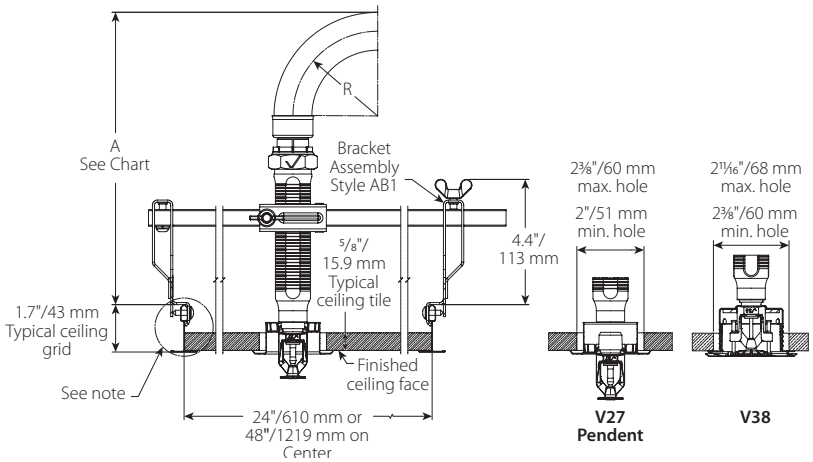
Item	Description
1	Style ABMM Bracket Body
2	Cap Screw, Serated Flange, M6 x 1 x 15.24, T25 Torx Drive Recessed

 © 2019 Victaulic Company. All rights reserved.

4.4 DIMENSIONS

Clearances

Series AH2 Braided Hose and Style AB1 Bracket



Hose Clearance Chart								
	Straight Reducer						Long Elbow	Short Elbow
	V2707 ¾" Max Recess inches mm	**V3802 ½" Max Recess** inches mm	**V2707 ¾" Max Recess** inches mm	**V3802 ½" Max Recess** inches mm	**V2707 ¾" Max Recess** inches mm	**V3802 ½" Max Recess** inches mm	**V2707 ¾" Max Recess** inches mm	**V3802 ½" Max Recess** inches mm
"R" Minimum Bend Radius	2.0 50		3.0 80		7.0 175		–	
"A" Minimum Required Installation Space	8.6 218	10.1 269	9.6 244	11.1 281	13.6 345	15.1 383	5.8 147	5.8 147

NOTE

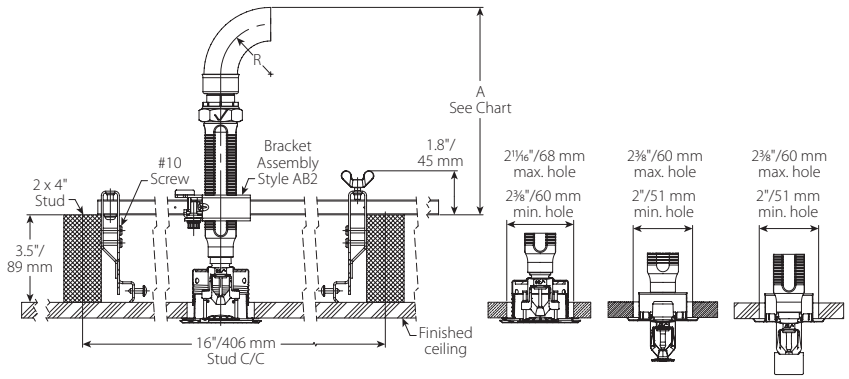
- Variations of ceiling grids, sprinkler heads, brackets, and hoses are permitted but may result in clearance differences from the figures above.

 © 2019 Victaulic Company. All rights reserved.

4.5 DIMENSIONS

Clearances

Series AH2 Braided Hose and Style AB2 Bracket



Hose Clearance Chart									
	Straight Reducer								
	V2707 ¾" I 20 mm Max Recess" inches mm	**V3802 ½" I 13 mm Max Recess** inches mm	**V2709 ¾" I 20 mm Sidewall** inches mm	**V2707 ¾" I 20 mm Max Recess** inches mm	**V3802 ½" I 13 mm Max Recess** inches mm	**V2709 ¾" I 20 mm Sidewall** inches mm	**V2707 ¾" I 20 mm Max Recess** inches mm	**V3802 ½" I 13 mm Max Recess** inches mm	**V2709 ¾" I 20 mm Sidewall** inches mm
"R" Minimum Bend Radius	2.0 50			3.0 80			7.0 175		
"A" Minimum Required Installation Space	6.2 158	7.6 193	6.1 155	7.2 183	8.6 218	7.1 180	11.2 285	12.6 320	11.1 282

Hose Clearance Chart			
	Long Elbow		Short Elbow
	V2707 ¾" I 20 mm Max Recess inches mm	**V2709 ¾" I 20 mm Sidewall** inches mm	**V3802 ½" I 13 mm Max Recess** inches mm
"R" Minimum Bend Radius	–		
"A" Minimum Required Installation Space	3.3 84	3.6 91	3.3 84

NOTE

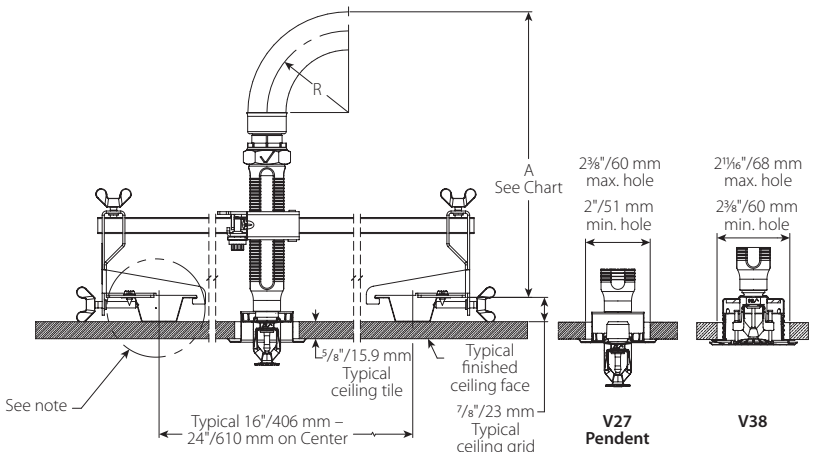
- Variations of ceiling grids, sprinkler heads, brackets, and hoses are permitted but may result in clearance differences from the figures above.

 © 2019 Victaulic Company. All rights reserved.

4.6 DIMENSIONS

Clearances

Series AH2 Braided Hose and Style AB4 Bracket



Hose Clearance Chart								
	Straight Reducer						Long Elbow	Short Elbow
	V2707 ¾" Max Recess inches mm	V3802 ½" Max Recess inches mm	V2707 ¾" Max Recess inches mm	V3802 ½" Max Recess inches mm	V2707 ¾" Max Recess inches mm	V3802 ½" Max Recess inches mm	V2707 ¾" Max Recess inches mm	V3802 ½" Max Recess inches mm
"R" Minimum Bend Radius	2.0 50	2.0 50	3.0 80	3.0 80	7.0 175	7.0 175	–	
"A" Minimum Required Installation Space	8.8 224	10.2 259	9.8 249	11.2 285	13.8 351	15.2 386	8.0 203	5.9 150

NOTE

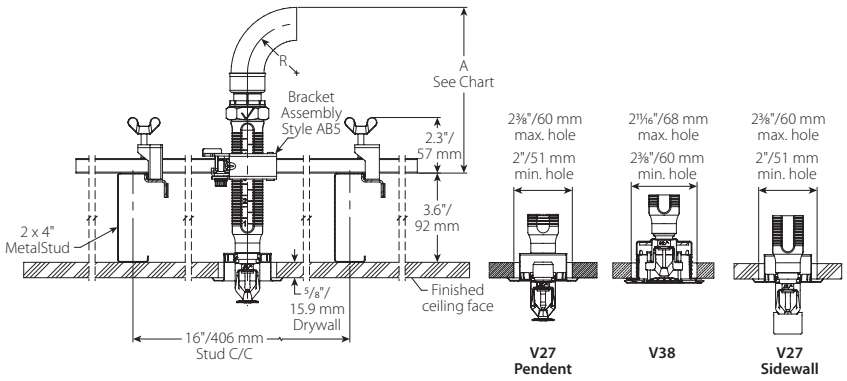
Variations of ceiling grids, sprinkler heads, brackets, and hoses are permitted but may result in clearance differences from the figures above.

 © 2019 Victaulic Company. All rights reserved.

4.7 DIMENSIONS

Clearances

Series AH2 Braided Hose and Style AB5 Bracket



Hose Clearance Chart									
	Straight Reducer								
	"V2707 ¾" I 20 mm Max Recess" inches mm	V3802 ½" I 13 mm Max Recess inches mm	V2709 ¾" I 20 mm Sidewall inches mm	V2707 ¾" I 20 mm Max Recess inches mm	V3802 ½" I 13 mm Max Recess inches mm	V2709 ¾" I 20 mm Sidewall inches mm	V2707 ¾" I 20 mm Max Recess inches mm	V3802 ½" I 13 mm Max Recess inches mm	V2709 ¾" I 20 mm Sidewall inches mm
"R" Minimum Bend Radius	2.0 50			3.0 80			7.0 175		
"A" Minimum Required Installation Space	6.0 158	7.7 196	6.1 155	7.0 178	8.7 221	7.1 180	11.0 279	12.7 323	11.1 282

Hose Clearance Chart					
	Long Elbow			Low-Profile Long Elbow	Short Elbow
	V2707 ¾" I 20 mm Max Recess inches mm	V3802 ½" I 13 mm Max Recess inches mm	V2709 ¾" I 20 mm Sidewall inches mm	V3802 ½" I 13 mm Max Recess inches mm	V3802 ½" I 13 mm Max Recess inches mm
"R" Minimum Bend Radius	–				
"A" Minimum Required Installation Space	3.5 89	4.9 124	3.6 91	2.9 74	3.3 84

NOTE

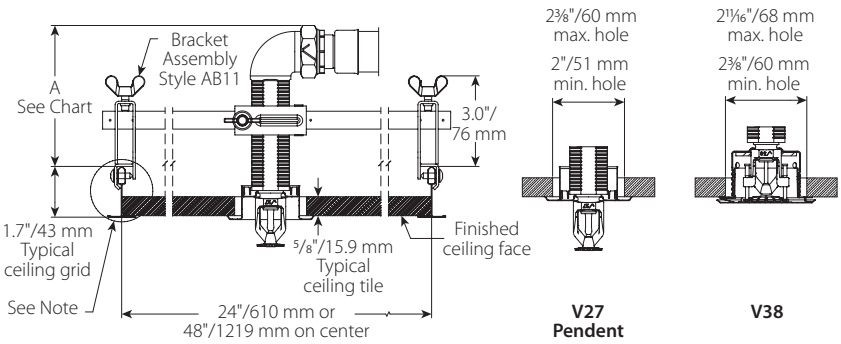
- Variations of ceiling grids, sprinkler heads, brackets, and hoses are permitted but may result in clearance differences from the figures above.

 © 2019 Victaulic Company. All rights reserved.

4.8 DIMENSIONS

Clearances

Series AH2 Braided Hose and Style AB11 Bracket (LOW PROFILE SOLUTION)



Hose Clearance Chart		
	Low-Profile Long Elbow	**Low-Profile Short Elbow**
	V2707 ¾" I 20 mm Max Recess" inches mm	**V3802 ½" I 13 mm Max Recess** inches mm
"A" Minimum Required Installation Space	4.0 102	3.9 99

NOTE

- Variations of ceiling grids, sprinkler heads, brackets, and hoses are permitted but may result in clearance differences from the figures above.

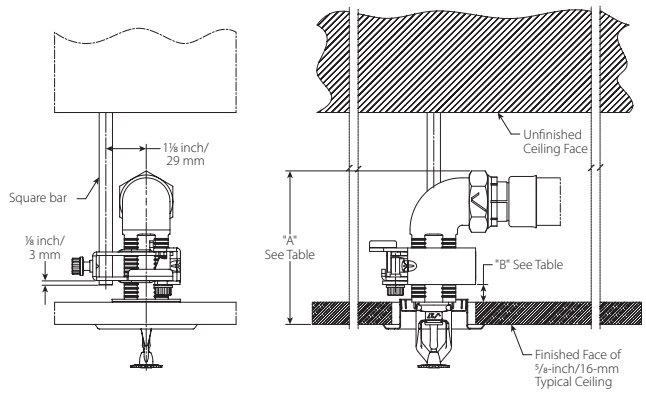
 © 2019 Victaulic Company. All rights reserved.

4.9 DIMENSIONS

Clearances

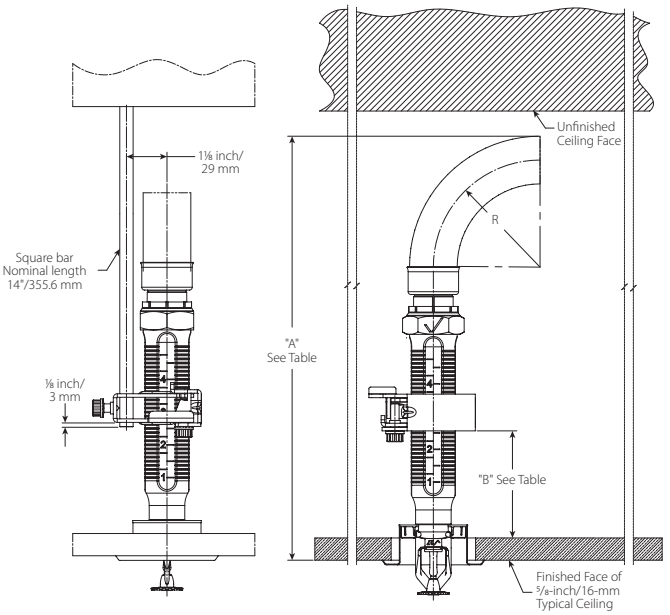
Style AB12 and ABBA Bracket

Suspended Ceiling Grid with Recessed Sprinkler with Low Profile Short Elbow



V2707 ½"/12.7 mm MAX. RECESS

Suspended Ceiling Grid with Recessed Sprinkler and Straight 5.75"/140 mm Reducer



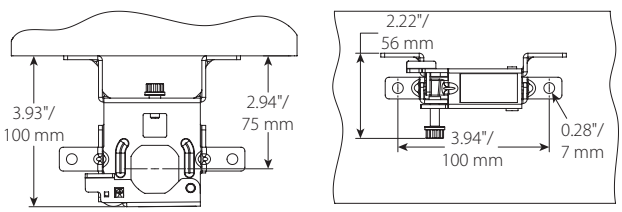
V2707 ¾"/19 mm MAX. RECESS

Dimension		Low Profile Short Elbow		Low Profile Long Elbow		Standard Short Elbow		Standard Long Elbow		Standard Straight Reducer	
		¾"/19 mm Recessed* inches mm	Concealed inches mm	¾"/19 mm Recessed inches mm	Concealed inches mm	¾"/19 mm Recessed inches mm	Concealed inches mm	¾"/19 mm Recessed inches mm	Concealed inches mm	¾"/19 mm Recessed inches mm	Concealed inches mm
A	Minimum Required Installation Space	4.0 101.6	5.5 139.7	5.6 142.2	7.2 182.9	5.9 149.9	7.5 190.5	7.7 195.6	9.3 236.2	15.0 381.0	16.6 421.6
B	Distance from Top of Typical Ceiling Tile to Bottom of Gate	0.5 12.7	2.0 50.8	1.5 38.1	1.5 38.1	1.5 38.1	1.5 38.1	3.0 76.2	3.0 76.2	3.0 76.2	3.0 76.2

* Adjustability will be limited

Style ABMM Bracket

Stand-off Dimensions



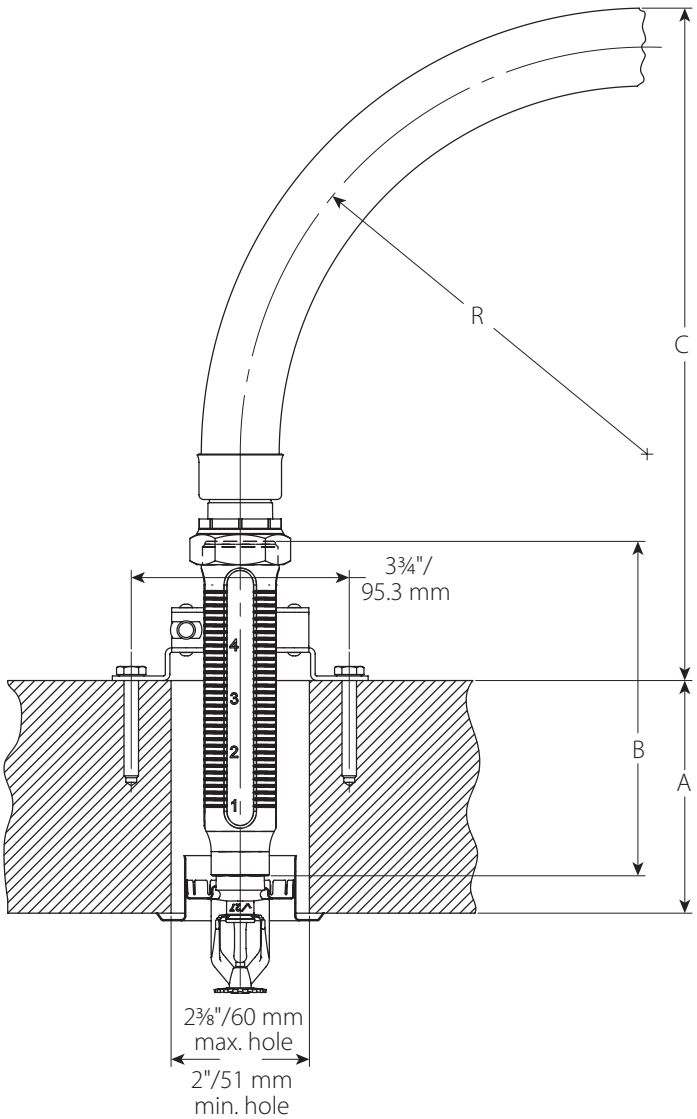
 © 2019 Victaulic Company. All rights reserved.

4.10 DIMENSIONS

Clearances

Style AB3 and ABMM Bracket

Surface Mount Application with Recessed Sprinkler



Hose Clearances																					
Dimension	inches mm			inches mm			inches mm		inches mm	inches mm	inches mm				inches mm			inches mm			inches mm	inches mm
Wall Thickness "A"	2 50			4 100			6 150		8 200	10 250	2 50				4 100			6 150			8 200	10 250
Outlet Length "B"	5.75 146.1	9 228.6	13 330.2	5.75 146.1	9 228.6	13 330.2	9 228.6	13 330.2	13 330.2	13 330.2	5.75 146.1	9 228.6	13 330.2	5.75 146.1	9 228.6	13 330.2	9 228.6	13 330.2	13 330.2	13 330.2
Hose Clearance "C"	11.6 294	14.8 376	18.8 478	9.6 243	12.8 325	16.8 427	10.8 275	14.8 376	12.8 325	10.8 275	12.6 319	15.8 402	19.8 503	10.6 268	13.8 351	17.8 452	11.8 300	15.8 402	13.8 351	11.8 300
Bend Radius "R"	7 175										8 200									

NOTE

- Variations of ceiling grids, sprinkler heads, brackets, and hoses are permitted but may result in clearance differences from the figures above.

 © 2019 Victaulic Company. All rights reserved.

5.0 PERFORMANCE – FRICTION LOSS DATA

Series AH2 and AH2-CC Braided Hoses with Straight 5.75"/140 mm Reducers Style AB1, AB2, AB4, AB5 and AB10 Brackets

inches/mm	inches/mm/type	Equivalent Length of 1"/33.7 mm Sch. 40 Pipe (C=120) feet/meters	Maximum Number of 90° Bends at 2"/51 mm Bend Radius
31/790	½"/15/Straight	16/4.9	4
	¾"/20/Straight	17/5.2	4
36/915	½"/15/Straight	21/6.4	5
	¾"/20/Straight	23/7.0	5
48/1220	½"/15/Straight	32/9.8	8
	¾"/20/Straight	37/11.3	8
60/1525	½"/15/Straight	46/14.0	10
	¾"/20/Straight	46/14.0	10
72/1830	½"/15/Straight	55/16.8	12
	¾"/20/Straight	53/16.2	12

Series AH2 and AH2-CC Braided Hose with 90° Low Profile Elbows Style AB11 *VicFlex* Bracket

inches/mm	inches/mm	Equivalent Length of 1"/33.7 mm Sch. 40 Pipe feet/meters	Maximum Number of 90° Bends at 2"/51 mm Bend Radius
31/790	½"/15	24/7.3	4
	¾"/20	24/7.3	4
36/915	½"/15	26/7.9	5
	¾"/20	28/8.5	5
48/1220	½"/15	43/13.1	8
	¾"/20	42/12.8	8
60/1525	½"/15	49/14.9	10
	¾"/20	50/15.2	10
72/1830	½"/15	65/19.8	12
	¾"/20	63/19.2	12

 © 2019 Victaulic Company. All rights reserved.

5.0 PERFORMANCE – FRICTION LOSS DATA (CONTINUED)

Series AH2 and AH2-CC Braided Hoses Equivalent Length Design Guide

Equivalent length values at various numbers of 90 degree bends at 2"/51 mm center line bend radius

Length of Stainless Steel Flexible Hose inches/ mm	Outlet Size inches/ mm	1 Bend feet/ meters	2 Bends feet/ meters	3 Bends feet/ meters	4 Bends feet/ meters	5 Bends feet/ meters	6 Bends feet/ meters	7 Bends feet/ meters	8 Bends feet/ meters	9 Bends feet/ meters	10 Bends feet/ meters	11 Bends feet/ meters	12 Bends feet/ meters
31/790	½"/15	8.5/2.6	11.0/3.4	13.0/4.0	16.0/4.9	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A
	¾"/20	10.0/3.0	12.5/3.8	14.0/4.3	17.0/5.2	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A
36/915	½"/15	13.5/4.1	16.0/4.9	18.0/5.5	19.0/5.8	21.0/6.4	N.A	N.A	N.A	N.A	N.A	N.A	N.A
	¾"/20	14.0/4.3	17.0/5.2	19.5/5.9	20.0/6.1	23.0/7.0	N.A	N.A	N.A	N.A	N.A	N.A	N.A
48/1220	½"/15	15.5/4.7	17.0/5.2	19.5/5.9	20.0/6.1	21.0/6.4	22.0/6.7	28.0/8.5	32.0/9.8	N.A	N.A	N.A	N.A
	¾"/20	17.0/5.2	19.0/5.8	21.5/6.6	24.5/7.5	26.0/7.9	27.0/8.2	30.0/9.1	37.0/11.3	N.A	N.A	N.A	N.A
60/1525	½"/15	21.5/6.6	24.0/7.3	27.0/8.2	28.5/8.7	30.0/9.1	31.0/9.4	37.0/11.3	42.0/12.8	44.0/13.4	46.0/14.0	N.A	N.A
	¾"/20	23.0/7.0	24.0/7.3	28.0/8.5	29.5/9.0	30.5/9.3	31.0/9.4	38.0/11.6	42.0/12.8	44.0/13.4	46.0/14.0	N.A	N.A
72/1830	½"/15	30.0/9.1	32.0/9.8	36.5/11.1	37.5/11.4	40.5/12.5	41.0/12.8	42.0/12.8	46.0/14.0	49.0/14.9	52.0/15.8	54.0/16.5	55.0/16.8
	¾"/20	32.0/9.8	32.5/9.9	35.0/10.7	35.5/10.8	40.0/12.3	40.5/12.3	41.0/12.5	46.0/14.0	50.0/15.2	51.0/15.5	52.0/15.8	53.0/16.2

NOTES:

- Values for use with 5.75"/140 mm straight reducers.

How to use this Design Guide:

- For some systems, it may be advantageous for the designer to calculate the system hydraulics using shorter equivalent lengths associated with fewer than the maximum allowable number of bends. In this case, the designer may select a design number of bends for the job and use the associated equivalent length from the design guide to determine the system hydraulics.
- It is possible that the actual installed condition of some of the flexible drops may have more bends than the designer selected. When this happens, the design guide may be used to find equivalent lengths based on the actual installed number of bends for particular sprinkler installations. The system hydraulics can be recalculated using actual equivalent lengths to verify the performance of the system.

 © 2019 Victaulic Company. All rights reserved.

5.1 PERFORMANCE – FRICTION LOSS DATA

Series AH2 and AH2-CC Braided Hoses
Style AB1, AB2, AB3, AB4, AB5, AB7, AB7 Adj., AB8, AB10, AB12, ABBA and ABMM *VicFlex* Brackets

Length of Stainless Steel Flexible Hose inches/mm	K-Factor Imperial/S.I.	Outlet Size inches/mm/type	Equivalent Length of 1"/33.7 mm Sch. 40 Pipe feet/meters	Maximum Number of 90° Bends at 7"/178 mm Bend Radius
31/790	5.6/8.1	½"/15/Straight	13.8/4.2	2
		½"/15/90° Elbow	23.5/7.1	
36/915	5.6/8.1	½"/15/Straight	16.6/5.1	2
		½"/15/90° Elbow	25.6/7.8	
48/1220	5.6/8.1	½"/15/Straight	23.4/7.1	3
		½"/15/90° Elbow	30.7/9.3	
60/1525	5.6/8.1	½"/15/Straight	30.2/9.2	4
		½"/15/90° Elbow	35.9/10.9	
72/1830	5.6/8.1	½"/15/Straight	37.0/11.3	4
		½"/15/90° Elbow	41.1/12.5	
31/790	8.0/11.5	¾"/20/Straight	16.8/5.1	2
		¾"/20/90° Elbow	16.8/5.1	
36/915	8.0/11.5	¾"/20/Straight	20/6.0	2
		¾"/20/90° Elbow	19.7/6.0	
48/1220	8.0/11.5	¾"/20/Straight	27.8/8.4	3
		¾"/20/90° Elbow	26.6/8.1	
60/1525	8.0/11.5	¾"/20/Straight	35.7/10.9	4
		¾"/20/90° Elbow	33.6/10.2	
72/1830	8.0/11.5	¾"/20/Straight	43.5/13.2	4
		¾"/20/90° Elbow	40.6/12.2	
31/790	11.2/16.1	¾"/20/Straight	16.5/5.0	2
		¾"/20/90° Elbow	17.8/5.4	
36/915	11.2/16.1	¾"/20/Straight	19.5/5.9	2
		¾"/20/90° Elbow	20.7/6.3	
48/1220	11.2/16.1	¾"/20/Straight	26.7/8.1	3
		¾"/20/90° Elbow	27.9/8.5	
60/1525	11.2/16.1	¾"/20/Straight	33.9/10.3	4
		¾"/20/90° Elbow	35/10.7	
72/1830	11.2/16.1	¾"/20/Straight	41.3/12.5	4
		¾"/20/90° Elbow	42.2/12.8	
31/790	14.0/20.2	¾"/20/Straight	14.9/4.5	2
		¾"/20/90° Elbow	15.5/4.72	
36/915	14.0/20.2	¾"/20/Straight	19.4/5.9	2
		¾"/20/90° Elbow	19.6/5.9	
48/1220	14.0/20.2	¾"/20/Straight	30.3/9.2	3
		¾"/20/90° Elbow	29.5/8.9	
60/1525	14.0/20.2	¾"/20/Straight	33.9/10.3	4
		¾"/20/90° Elbow	34.1/10.4	
72/1830	14.0/20.2	¾"/20/Straight	37.5/11.4	4
		¾"/20/90° Elbow	38.6/11.7	

FM NOTES:

- The Series AH2 hose has been tested and Approved by FM Global for use in wet, dry and preaction systems per NFPA 13, 13R, and 13D and FM data sheets 2-0, 2-5, and 2-8. FM 1637 standard for safety include, but are not limited to, pressure cycling, corrosion resistance, flow characterisitics, vibration resistance, leakage, mechanical and hydrostatic strength.
- EXAMPLE: A 48-inch hose installed with two 30° bends and two 90° bends is permitted and considered equivalent to the data in the table shown above. In this example, the total number of degrees is 240°, which is less than the allowable 270°.

 © 2019 Victaulic Company. All rights reserved.

5.2 PERFORMANCE – FRICTION LOSS DATA

Series AH2 Braided Hose with 90° Low Profile Elbows Style AB5, AB11, AB12, ABBA and ABMM *VicFlex* Bracket

Length of Stainless Steel Flexible Hose inches/mm	K-Factor Imperial/S.I.	Outlet Size inches/mm	Equivalent Length of 1"/33.7mm Sch. 40 Pipe feet/meters	Maximum Number of 90° Bends at 7"/178mm Bend Radius
31/790	5.6/8.1	½"/15	13.7/4.2	2
36/915	5.6/8.1	½"/15	17.0/5.2	2
48/1220	5.6/8.1	½"/15	25.0/7.6	3
60/1525	5.6/8.1	½"/15	33.0/10.1	4
72/1830	5.6/8.1	½"/15	41.1/12.5	4
31/790	8.0/11.5	¾"/20	13.6/4.14	2
36/915	8.0/11.5	¾"/20	16.9/5.2	2
48/1220	8.0/11.5	¾"/20	27.8/8.5	3
60/1525	8.0/11.5	¾"/20	32.6/9.9	4
72/1830	8.0/11.5	¾"/20	40.6/12.4	4
31/790	11.2/16.1	¾"/20	13.7/4.2	2
36/915	11.2/16.1	¾"/20	17.0/5.2	2
48/1220	11.2/16.1	¾"/20	24.9/7.6	3
60/1525	11.2/16.1	¾"/20	32.9/10.0	4
72/1830	11.2/16.1	¾"/20	40.9/12.5	4
31/790	14.0/20.2	¾"/20	13.5/4.1	2
36/915	14.0/20.2	¾"/20	16.8/5.1	2
48/1220	14.0/20.2	¾"/20	24.7/7.5	3
60/1525	14.0/20.2	¾"/20	32.7/9.9	4
72/1830	14.0/20.2	¾"/20	40.7/12.4	4

FM NOTES:

- The Series AH2 hose has been tested and Approved by FM Global for use in wet, dry and preaction systems per NFPA 13, 13R, and 13D and FM data sheets 2-0, 2-5, and 2-8. FM 1637 standard for safety include, but are not limited to, pressure cycling, corrosion resistance, flow characterisitics, vibration resistance, leakage, mechanical and hydrostatic strength.
- EXAMPLE: A 48-inch hose installed with two 30° bends and two 90° bends is permitted and considered equivalent to the data in the table shown above. In this example, the total number of degrees is 240°, which is less than the allowable 270°.

 © 2019 Victaulic Company. All rights reserved.

5.3 PERFORMANCE – FRICTION LOSS DATA

Series AH2 and AH2-CC Braided Hose
Style AB1, AB2, AB4, AB5, AB7, AB7 Adj., AB8, AB10, AB11 and AB12 Brackets

Length of Stainless Steel Flexible Hose mm/inches	Outlet Size mm/inches	Equivalent Length of steel pipe according to EN 10255 DN 25 (33,7 x 3,25) meters/feet	Maximum Number of 90° Bends at 3"/76.2 mm Bend Radius meters/feet
31/790	15 mm/½" 20 mm/¾"	5.5/18.0	3
36/915	15 mm/½" 20 mm/¾"	6.4/21.0	3
48/1220	15 mm/½" 20 mm/¾"	8.5/27.9	3
60/1525	15 mm/½" 20 mm/¾"	10.7/35.1	4
72/1830	15 mm/½" 20 mm/¾"	12.8/42.0	4

VDS CEILING MANUFACTURERS LIST

AB1, AB2, AB7, AB10 ,AB11

1. AMF
2. Armstrong
3. Chicago Metallic
4. Dipling
5. Durlum
6. Geipel
7. Gema-Armstrong
8. Hilti
9. Knauf
10. Lafarge
11. Linder
12. Odenwald
13. Richter
14. Rigips
15. Rockfon Pagos
16. Suckow & Fischer
17. USG Donn

AB4

No specific approval

AB5, AB8

1. Hilti
2. Knauf
3. Lafarge
4. Lindner
5. Rigips

Series AH2 and AH2-CC Braided Hose
Style AB1, AB2, AB3, AB4, AB5, AB7, AB8, and AB10 Brackets

Length of Stainless Steel Flexible Hose mm/inches	Outlet Size mm/inches/type	Equivalent Length of steel pipe according to EN 10255 DN 25 (33,7 x 3,25) meters/feet	Maximum Number of 90° Bends at 3"/76.2 mm Bend Radius
790/31	15 mm/½"/Straight 20 mm/¾"/Straight	1.8/6.0	2
915/36	15 mm/½"/Straight 20 mm/¾"/Straight	3.6/11.9	3
1220/48	15 mm/½"/Straight 20 mm/¾"/Straight	4.3/14.0	3
1525/60	15 mm/½"/Straight 20 mm/¾"/Straight	4.1/13.6	3
1830/72	15 mm/½"/Straight 20 mm/¾"/Straight	5.5/18.1	3

Series AH2 Braided Hose
Style AB1, AB2, AB3, AB4, AB5, AB7, AB8, AB10 and AB12 Brackets

Length of Flexible Hose mm inches	Equivalent Length of 1"/33.7 mm Sch. 40 Pipe Straight Configuration	 Bend Configuration
790 31	0.87 2.9	2.70 8.9
915 36	1.00 3.3	2.80 9.2
1220 48	2.23 7.3	4.66 15.3
1525 60	2.90 9.5	6.5 21.3
1830 72	3.31 10.9	7.16 23.5

CCCF NOTE

- Friction loss data is in accordance with GB5135.16 tested at a flow rate of 114 liters per minute (30 gallons per minute).

 © 2019 Victaulic Company. All rights reserved.

6.0 NOTIFICATIONS

WARNING

- **Read and understand all instructions before attempting to install, remove, adjust, or maintain any Victaulic piping products.**
- **Always verify that the piping system has been completely depressurized and drained immediately prior to installation, removal, adjustment, or maintenance of any Victaulic products.**
- **Wear safety glasses, hardhat, and foot protection.**

Failure to follow these instructions could result in death or serious personal injury and property damage.

WARNING

- **It is the responsibility of the system designer to verify suitability of 300-series stainless steel flexible hose for use with the intended fluid media within the piping system and external environments.**
- **The effect of chemical composition, pH level, operating temperature, chloride level, oxygen level, and flow rate on 300-series stainless steel flexible hose must be evaluated by the material specifier to confirm system life will be acceptable for the intended service.**

Failure to follow these instructions could cause product failure, resulting in serious personal injury and/or property damage.

 © 2019 Victaulic Company. All rights reserved.

7.0 REFERENCE MATERIALS – CHARACTERISTICS

VicFlex Maximum Load Values

Series AH2 Hose with 24" Bracket

Model Size	Actual Length ft m	Total Load lb	Total Load N	Max. Uniform Load lb/linear ft	Max. Uniform Load N/linear m
31/790	2.6 0.8	5.2	23	2.6	38
36/915	3 0.9	5.5	25	2.8	40
48/1220	4 1.2	6.3	28	3.1	46
60/1525	5 1.5	7.0	31	3.5	51
72/1830	6 1.8	7.7	34	3.9	57

Series AH2 Hose with 48" Bracket

Model Size	Actual Length ft m	Total Load lb	Total Load N	Max. Uniform Load lb/linear ft	Max. Uniform Load N/linear m
31/790	2.6 0.8	6.1	27	1.5	22
36/915	3 0.9	6.4	29	1.6	23
48/1220	4 1.2	7.2	32	1.8	26
60/1525	5 1.5	7.9	35	2.0	29
72/1830	6 1.8	8.7	39	2.2	32

Total Load is defined as the sum of the weights of the following:

- water-filled flexible sprinkler hose with threaded end fittings, including a typical fire sprinkler
- bracket assembly (any applicable Victaulic bracket model of the relevant associated size)

ASTM C 635: Suspension System Load-Carrying Capabilities (excerpted)

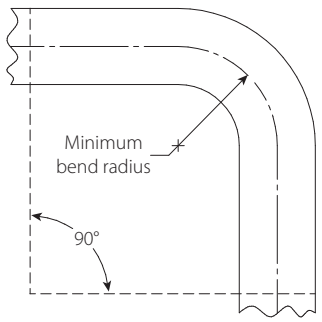
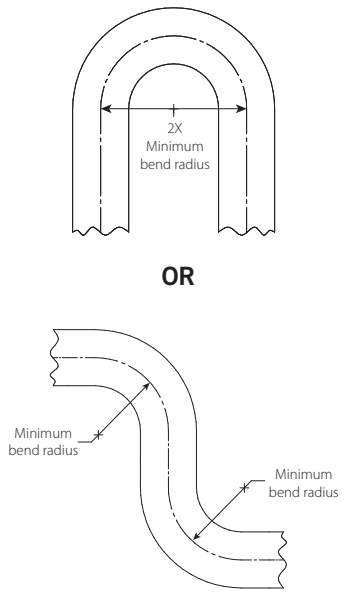
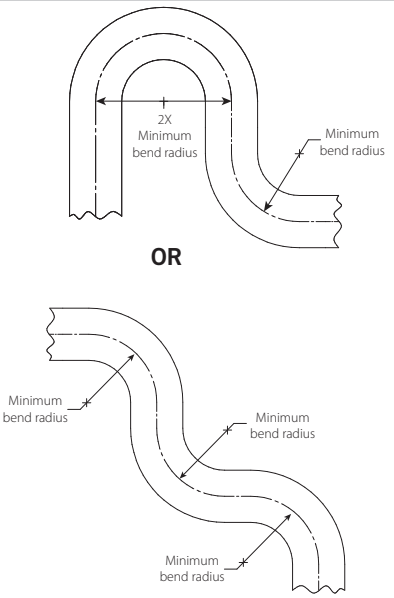
Suspension System	Actual Length ft/m	Min. Allowable Uniform Load lb/linear ft	Min. Allowable Uniform Load N/linear m
Direct Hung	Light	5.0	75.7
	Intermediate	12.0	181.0
	Heavy	16.0	241.7

SUMMARY: All direct-hung suspension system duty classifications per ASTM C 635 are able to withstand the maximum water-filled weight of the *VicFlex* sprinkler hose and bracket.

 © 2019 Victaulic Company. All rights reserved.

7.0 REFERENCE MATERIALS – CHARACTERISTICS (CONTINUED)

Flexible Hose In-Plane Bend Characteristics

One Bend	Two Bends	Three Bends
		

NOTE

For out-of-plane (three-dimensional) bends, care must be taken to avoid imparting torque on the hose.

I-VicFlex-AB1-AB2-AB10
I-VicFlex-AB3
I-VicFlex-AB4
I-VicFlex-AB7
I-VicFlex-AB8
I-VicFlex-AB12
I-VicFlex-ABBA
I-VicFlex-ABMM

User Responsibility for Product Selection and Suitability
Each user bears final responsibility for making a determination as to the suitability of Victaulic products for a particular end-use application, in accordance with industry standards and project specifications, and the applicable building codes and related regulations as well as Victaulic performance, maintenance, safety, and warning instructions. Nothing in this or any other document, nor any verbal recommendation, advice, or opinion from any Victaulic employee, shall be deemed to alter, vary, supersede, or waive any provision of Victaulic Company's standard conditions of sale, installation guide, or this disclaimer.

Intellectual Property Rights
No statement contained herein concerning a possible or suggested use of any material, product, service, or design is intended, or should be constructed, to grant any license under any patent or other intellectual property right of Victaulic or any of its subsidiaries or affiliates covering such use or design, or as a recommendation for the use of such material, product, service, or design in the infringement of any patent or other intellectual property right. The terms "Patented" or "Patent Pending" refer to design or utility patents or patent applications for articles and/or methods of use in the United States and/or other countries.

Note
This product shall be manufactured by Victaulic or to Victaulic specifications. All products to be installed in accordance with current Victaulic installation/assembly instructions. Victaulic reserves the right to change product specifications, designs and standard equipment without notice and without incurring obligations.

Installation
Reference should always be made to I-VICFLEX-AB1-AB2-AB10, I-VICFLEX-AB4, I-VICFLEX-AB7, or I-VICFLEX-AB8 for the product you are installing. Handbooks are included with each shipment of Victaulic products for complete installation and assembly data, and are available in PDF format on our website at www.victaulic.com.

Warranty
Refer to the Warranty section of the current Price List or contact Victaulic for details.

Trademarks
Victaulic and all other Victaulic marks are the trademarks or registered trademarks of Victaulic Company, and/or its affiliated entities, in the U.S. and/or other countries.

 © 2019 Victaulic Company. All rights reserved.

HANGER MATERIAL

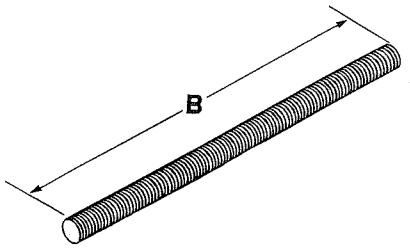
Fig. 10 THREADED STUDS

FUNCTION: Designed for use in pipe hanger assembly.

MATERIAL: Low carbon steel

FINISH: Plain

ORDERING: Specify rod size, length (B) and figure number.



Rod Size	Max. Rec. Load/lbs.		Wt. Per Inch/lbs.
	650°F	750°F	
⅜ x B	610	540	.02
½ x B	1130	1010	.04
⅝ x B	1810	1610	.07
¾ x B	2710	2420	.11
⅞ x B	3770	3360	.14

Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.

Fig. 15 & 15L MACHINE THREAD HANGER ROD

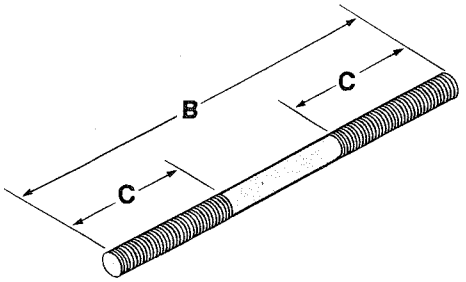
FUNCTION: Designed for use in pipe hanger assembly.

MATERIAL: Low carbon steel

FINISH: Plain

ORDERING: Specify rod size, length (B) and figure number.

Fig. 15 RIGHT-HAND THREADS
Fig. 15L RIGHT- AND LEFT-HAND THREADS



Rod Size	Thread Length C	Max. Rec. Load/lbs.		Wt. Per Inch/lbs.
		650°F	750°F	
⅜ x B	2½	610	540	.03
½ x B	2½	1130	1010	.06
⅝ x B	2½	1810	1610	.09
¾ x B	3	2710	2420	.13
⅞ x B	3½	3770	3360	.17
1 x B	4	4960	4420	.22

Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.

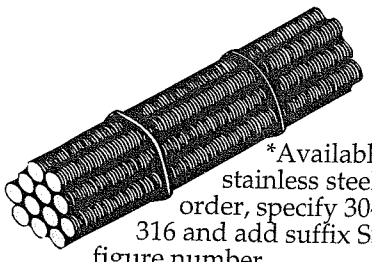
Fig. 20 & 21 CONTINUOUS THREADED ROD

FUNCTION: Useful in applications where stud lengths cannot be predetermined.

MATERIAL: Low carbon steel

ORDERING: Specify rod size, length and figure number.

Fig. 20* PLAIN
Fig. 21 ELECTRO-GALVANIZED

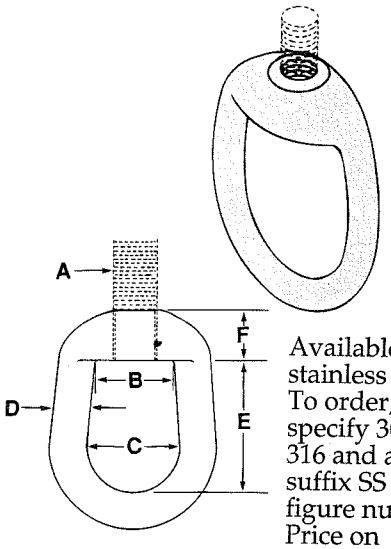


*Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.

Rod Size	Packaging Feet Per Bundle			Max. Rec. Load/lbs.		Wt. Per Foot/lbs.
	6 ft.	10 ft.	12 ft.	650°F	750°F	
¼-20	300	500	600	240	210	.12
⅜-16	150	200	240	610	540	.29
½-13	72	120	144	1130	1010	.54
⅝-11	48	80	96	1810	1610	.83
¾-10	30	50	60	2710	2420	1.25
⅞-9	24	40	48	3770	3360	1.65
1-8	12	20	24	4960	4420	2.25

Fig. 35 & 35L
WELDLESS EYE NUT

Fig. 35 RIGHT-HAND THREADS
Fig. 35L LEFT-HAND THREADS



Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number. Price on request.

MATERIAL: Forged steel

FINISH: Plain

FUNCTION: Designed for use in high strength and high temperature piping applications. Fig. 35L is designed to be used in conjunction with Fig. 960 forged steel turnbuckle, in applications where a vertical adjustment may be necessary.

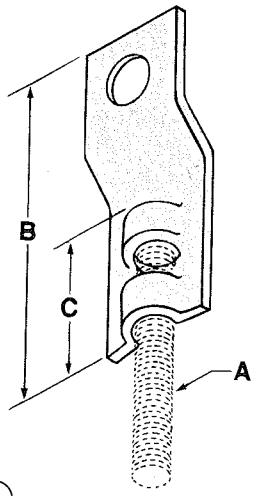
APPROVALS: Complies with Federal Specifications A-A-1192A (Type 17) and Manufacturers' Standardization Society SP-69 (Type 17).

ORDERING: Specify rod size and figure number.

Rod Size A	B	C	D	E	F	Max. Rec. Load/lbs. 650°F	Max. Rec. Load/lbs. 750°F	Wt. Each (in lbs.)
3/8	1 1/4	1 1/2	1/2	2	11/16	610	540	.64
1/2	1 1/4	1 1/2	1/2	2	11/16	1130	1010	.61
5/8	1 1/4	1 1/2	1/2	2	11/16	1810	1610	.59
3/4	1 1/4	1 1/2	1/2	2	11/16	2710	2420	.57
7/8	1 11/16	2	3/4	2 5/8	1	3770	3360	1.67
1	1 11/16	2	3/4	2 5/8	1	4960	4420	1.65
1 1/8	2 1/4	2 1/2	1	3 3/8	1 1/4	6230	5560	3.68
1 1/4	2 1/4	2 1/2	1	3 3/8	1 1/4	8000	7140	3.57
1 1/2	2 1/4	2 1/2	1	3 3/8	1 1/4	11630	10370	3.43

Note: Supports loads equal to the full limitation of the hanger rod.

Fig. 37
STEEL EYE SOCKET



FM APPROVED UL

MATERIAL: Low carbon steel

FINISH: Electro-galvanized

FUNCTION: Designed for attaching hanger rod to wood structures. Secured with Fig. 45 lag screw.

APPROVALS: Underwriters' Laboratories listed and Factory Mutual approved.

ORDERING: Specify rod size and figure number.

Rod Size A	Max. Pipe Size	Lag Screw Size	B	C	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
3/8	2	3/8 x 2 1/2	2 5/8	1 1/16	610	.09
1/2	6	1/2 x 3	2 3/4	1 3/16	1130	.11

Note: Offset design furnished only in 3/8 size allows installation to be flush.

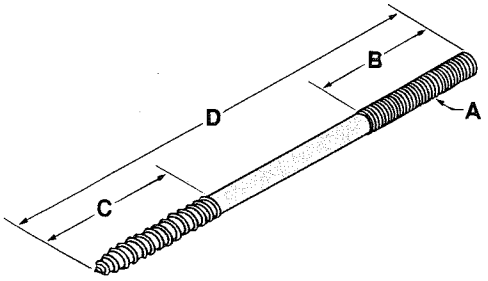
Fig. 40
COACH SCREW ROD

FUNCTION: Designed for use as a vertical hanger attachment to wood structures.

MATERIAL: Low carbon steel

FINISH: Plain or electro-galvanized

ORDERING: Specify rod size, length, finish and figure number.



Rod Size A	Minimum Length		Max. Rec. Load/lbs.	Wt. Each (in lbs.)				
	Machine B	Coach C		Length D (inches)				
				4	6	8	10	12
⅜	2	2	390	.12	.19	.25	.31	.37
½	2	2½	640	.22	.34	.44	.56	.67

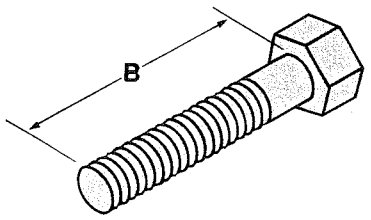
Fig. 41
HEX HEAD BOLT

FUNCTION: Designed for use as a fastening device.

MATERIAL: Low carbon steel

FINISH: Plain or electro-galvanized

ORDERING: Specify diameter, length, finish and figure number. If nuts are required, refer to Fig. 110 or 110H.

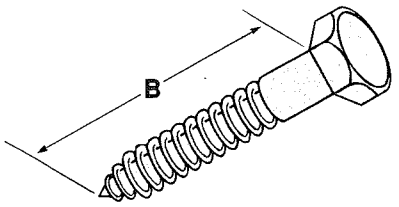


Available in stainless steel.
To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.

Length (inches) B	Wt. Each (in lbs.)			
	Diameter (inches)			
	⅝" Dia.	¾" Dia.	⅞" Dia.	1" Dia.
2	.23	.35	—	—
2¼	.25	.39	—	—
2½	.27	.42	.60	—
2¾	.29	.45	.64	.85
3	.32	.48	.68	.92
3¼	.34	.51	.72	.94
3½	.36	.54	.76	.96
3¾	.38	.57	.80	1.10
4	.40	.60	.85	1.11

Note: Regularly furnished without nut.

Fig. 45 LAG SCREW



FUNCTION: Designed for use as a fastening device to wood structures.

Length B	Wt. Each (in lbs.) 1/4 Rod	3/8 Rod	1/2 Rod	5/8 Rod
1½	.02	.06	—	—
2	.03	.07	.14	.23
2½	.03	.08	.16	.27
3	.04	.10	.19	.31
4	.05	.12	.23	.38

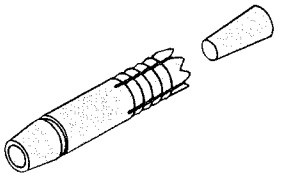
MATERIAL: Low carbon steel

FINISH: Plain

ORDERING: Specify rod size, length, and figure number.

Fig. 47 CONCRETE ANCHORS

Fig. 47D SELF DRILLING SNAP-OFF FLUSH



FUNCTION: Designed to function as a drill, drilling its own hole and as an anchor. The tapered chuck end of the anchor is attached to an air hammer, then after drilling is complete, the tapered end snaps off leaving the anchor flush with the wall. Useful when a large number of anchors are to be installed.

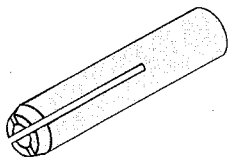
Rod Size	O.D.	Thread Depth	Hole Depth	Wt. Each (in lbs.)
3/8	9/16	9/16	1 17/32	.10
1/2	11/16	13/16	2 1/32	.18
5/8	27/32	15/16	2 15/32	.36

MATERIAL: Case hardened steel

FINISH: Electro-galvanized

ORDERING: Specify rod size and figure number.

Fig. 47S STEEL DROP-IN



FUNCTION: Designed to be inserted into a pre-drilled hole and set into place by means of a setting tool.

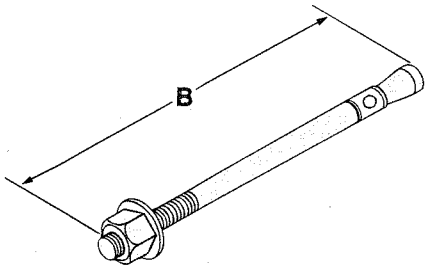
Rod Size	Hole Size	Anchor Length	Thread Length	Wt. Each (in lbs.)
3/8	1/2	1 9/16	5/8	.07
1/2	5/8	2	3/4	.13
5/8	3/4	2 1/2	1	.28

MATERIAL: Low carbon steel

FINISH: Electro-galvanized

ORDERING: Specify rod size and figure number.

Fig. 47W WEDGE



FUNCTION: Designed to be driven into a pre-drilled hole. The expansion of the case is controlled by the tightening of the nut, this eliminates the need for an exact hole size. Useful in applications where a high resistance to vibratory loads is desired.

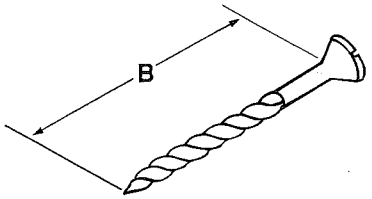
Rod Size	Thread Length	Minimum Embedment	Wt. Per Inch/lbs.
3/8 X B	1 1/8	1 5/8	.03
1/2 X B	1 1/4	2 1/4	.06
5/8 X B	1 1/2	2 3/4	.11

MATERIAL: Low carbon steel

FINISH: Electro-galvanized

ORDERING: Specify rod size, length (B) and figure number.

Fig. 48 WOOD DRIVE SCREW



FUNCTION: Designed for use as a fastening device to wood structures.

Size No.	Length B	Wt. Each (in lbs.)
12	1½	.014
12	2	.015
14	1½	.016
14	2	.018
16	2	.025

MATERIAL: Low carbon steel

FINISH: Plain or electro-galvanized

ORDERING: Specify size number length and figure number.

ROD COUPLINGS

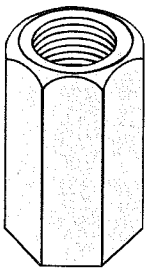
FUNCTION: Designed to provide a means of connecting two lengths of rod with equal diameters.

MATERIAL: Low carbon steel

FINISH: Plain or electro-galvanized

ORDERING: Specify rod size, finish and figure number.

Fig. 100 STANDARD ROD COUPLING



Rod Size	Length	Hex Width	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
1/4	7/8	3/8	230	.06
3/8	1 3/4	5/8	610	.11
1/2	1 3/4	11/16	1130	.11
5/8	2 1/8	13/16	1810	.17
3/4	2 1/4	1	2710	.28
7/8	2 1/2	1 1/4	3770	.56
1	2 3/4	1 3/8	4960	.72

Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.

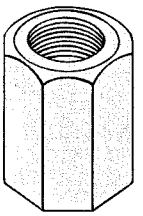
FUNCTION: Designed to provide a means of connecting two lengths of rod with equal diameters.

MATERIAL: Low carbon steel

FINISH: Plain

ORDERING: Specify rod size, and figure number.

Fig. 104 SHORT PATTERN ROD COUPLING



Rod Size	Length	Hex Width	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
3/8	1 1/8	1/2	610	.04
1/2	1 1/4	5/8	1130	.06

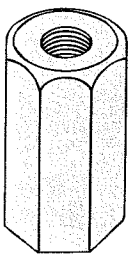
FUNCTION: Designed to provide a means of connecting two lengths of rod with different diameters.

MATERIAL: Low carbon steel

FINISH: Plain

ORDERING: Specify rod size, and figure number.

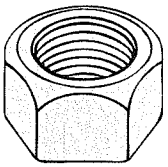
Fig. 105 REDUCING ROD COUPLING



Rod Size	Length	Hex Width	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
3/8 X 1/4	1	1/2	230	.04
1/2 X 3/8	1 1/4	5/8	610	.07
5/8 X 1/2	1 1/4	13/16	1130	.14
3/4 X 5/8	2 1/2	1	1810	.21
7/8 X 3/4	2 3/4	1 1/4	2710	.40

Fig. 110 & 110H HEX NUT

Fig. 110 STANDARD HEX NUT
Fig. 110H HEAVY HEX NUT

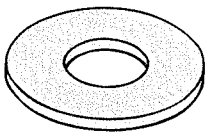


MATERIAL: Low carbon steel
FINISH: Plain or electro-galvanized
ORDERING: Specify rod size, finish and figure number.

Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number. Price on request.

	Wt. Each (in lbs.)										
Rod Size	1/4	5/16	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2
Fig. 110	.01	.01	.02	.04	.07	.12	.19	.28	.40	.54	.94
Fig. 110H	–	–	.03	.07	.12	.19	.30	.43	.59	.79	1.31

Fig. 130 FLAT WASHER

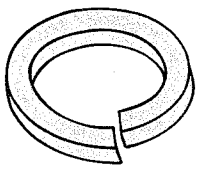


Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number. Price on request.

MATERIAL: Low carbon steel
FINISH: Plain or electro-galvanized
ORDERING: Specify rod size, finish and figure number.

Rod Size	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2
I.D.	5/16	7/16	9/16	11/16	13/16	15/16	1 1/16	1 1/4	1 3/8	1 5/8
O.D.	3/4	1	1 3/8	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/2
Wt. Each (in lbs.)	.01	.02	.04	.08	.11	.15	.19	.22	.26	.38

Fig. 134 LOCK WASHER

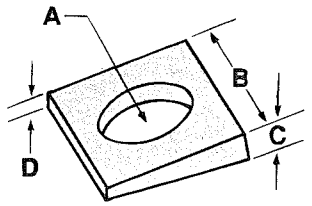


Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number. Price on request.

MATERIAL: Low carbon steel
FINISH: Plain or electro-galvanized
ORDERING: Specify rod size, finish and figure number.

Rod Size	I.D.	O.D.	Wt. Each (in lbs.)
3/8	7/16	11/16	.007
1/2	9/16	7/8	.015
5/8	11/16	1 1/16	.026
3/4	13/16	1 1/4	.043

Fig. 135 BEVEL WASHER

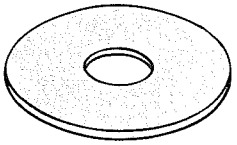


FUNCTION: Designed to be used on a tapered surface to permit the fastening of a bolt at a right angle.

MATERIAL: Malleable rod iron
FINISH: Plain or electro-galvanized
ORDERING: Specify rod size, finish, and figure number.

Rod Size A	B	C	D	Wt. Each (in lbs.)
3/8	1 1/4	11/32	5/32	.09
1/2	1 1/4	11/32	5/32	.09
5/8	1 3/4	13/32	5/32	.14
3/4	1 1/2	15/32	7/32	.16
7/8	2	9/16	7/32	.33

Fig. 136 FENDER WASHER



FUNCTION: Designed to provide a greater bearing surface diameter.

MATERIAL: Low carbon steel
FINISH: Electro-galvanized
ORDERING: Specify rod size and figure number.

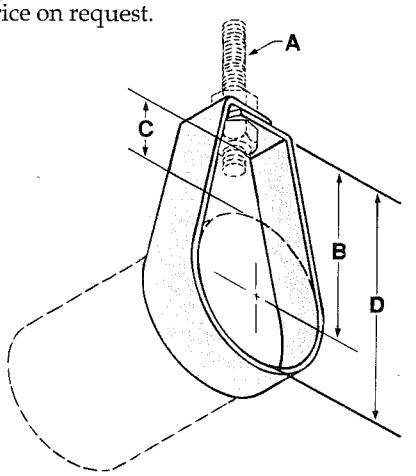
Rod Size	I. D.	O. D.	Wt. Each (in lbs.)
3/8	13/32	1 1/2	.03
1/2	17/32	2	.03

BAND HANGERS

Fig. 180, 180F, 181 & 183 BAND HANGER

Fig. 180* PLAIN
Fig. 180F* FELT LINED
Fig. 181 ELECTRO-GALVANIZED
Fig. 183 PLAIN WITH PVC COATING

*Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.



FUNCTION: Designed for the suspension of non-insulated stationary pipe lines. Fig. 180F has a layer of felt which separates the pipe from the hanger to reduce vibration and sound. The PVC coating on Fig. 183 protects the pipe from the metal surface of the hanger.

APPROVALS: Complies with Federal Specification A-A-1192A (Type 7) and Manufacturers' Standardization Society SP-69 (Type 7).

MATERIAL: Low carbon steel

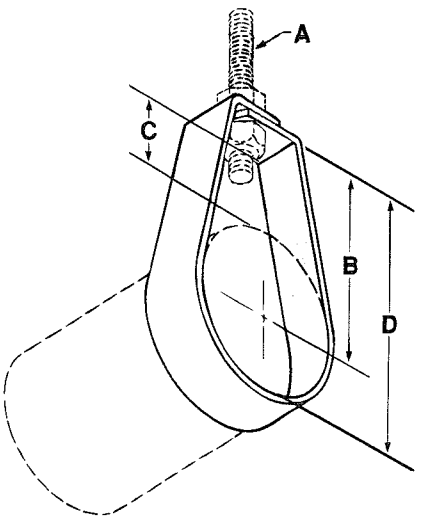
ORDERING: Specify pipe size and figure number.

Pipe Size	Rod Size A	B	Adj. C	D	Material Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
½	⅜	2¼	1⅜	2¹¹⁄₁₆	16 ga. X ⅞	610	.13
¾	⅜	2⅛	1⅛	2¹¹⁄₁₆	16 ga. X ⅞	610	.13
1	⅜	2⅛	1¹⁄₁₆	2¹³⁄₁₆	16 ga. X ⅞	610	.14
1¼	⅜	2⁵⁄₁₆	1	3³⁄₁₆	16 ga. X ⅞	610	.16
1½	⅜	2⁷⁄₁₆	1¹⁄₁₆	3⁷⁄₁₆	16 ga. X ⅞	610	.18
2	⅜	2⅞	1³⁄₁₆	4¹⁄₁₆	16 ga. X ⅞	610	.20
2½	½	3⅛	⅞	4⁷⁄₁₆	13 ga. X 1	970	.37
3	½	3¾	1⅜	5½	13 ga. X 1	970	.43
3½	½	3⅞	1¼	5⅞	13 ga. X 1	970	.47
4	½	4¼	1⅜	6½	11 ga. X 1	1250	.69
5	½	4¹³⁄₁₆	1½	7⅝	11 ga. X 1	1250	.82
6	¾	5¹⁵⁄₁₆	1¹¹⁄₁₆	9¼	11 ga. X 1½	1600	1.50
8	⅞	7¹⁵⁄₁₆	2½	12¼	11 ga. X 1½	1800	1.89

Note: Use of an upper locknut ensures proper performance. If ordering felt lined hangers for 3½ pipe or less, order the next largest size to allow for the thickness of the felt lining.

Fig. 182 COPPER TUBING BAND HANGER

Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.



FUNCTION: Designed for the suspension of non-insulated stationary copper tubing. When proper adjustment has been obtained, the hanger should be locked in place with an upper locknut.

APPROVALS: Complies with Federal Specification A-A-1192A (Type 7) and Manufacturers' Standardization Society SP-69 (Type 7).

MATERIAL: Low carbon steel

FINISH: Copper finish

ORDERING: Specify tube size and figure number.

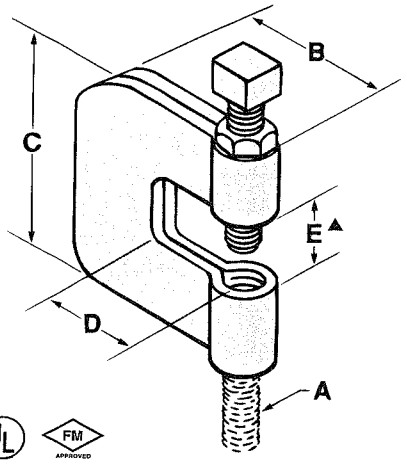
Tube Size	Rod Size A	B	Adj. C	D	Material Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
½	⅜	2⁷⁄₁₆	1⁵⁄₈	2¾	16 ga. X ⅞	610	.11
¾	⅜	2¾	1⁵⁄₁₆	2¹¹⁄₁₆	16 ga. X ⅞	610	.11
1	⅜	2⅛	1¹⁄₁₆	2¹¹⁄₁₆	16 ga. X ⅞	610	.11
1¼	⅜	2⅛	¹⁵⁄₁₆	2¹³⁄₁₆	16 ga. X ⅞	610	.12
1½	⅜	2⅜	1¹⁄₁₆	3⁷⁄₁₆	16 ga. X ⅞	610	.14
2	⅜	2⁹⁄₁₆	1	3⁵⁄₈	16 ga. X ⅞	610	.16
2½	⅜	2¹⁵⁄₁₆	1¹⁄₁₆	4¼	16 ga. X ⅞	610	.16
3	½	3¼	1	4¹³⁄₁₆	13 ga. X 1	970	.38
3½	½	3⁷⁄₁₆	1	5¼	13 ga. X 1	970	.42
4	½	3¾	1	5¹³⁄₁₆	13 ga. X 1	1250	.45

Note: Use of an upper locknut ensures proper performance.

Fig. 250 & 250-1 STEEL C-CLAMP

Fig. 250 WITH LOCKNUT
Fig. 250-1 WITHOUT LOCKNUT

*Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.



FUNCTION: Designed for attaching hanger rod to the bottom flange of a beam. The hanger rod should make contact with the beam flange to ensure full engagement.

APPROVALS: Underwriters' Laboratories listed and Factory Mutual approved. Complies with Federal Specification A-A-1192A (Type 23) and Manufacturers' Standardization Society SP-69 (Type 23) (Approvals are only for Fig. 250 with locknut).

MATERIAL: Low carbon steel with hardened steel cup point set screw

FINISH: Plain or electro-galvanized

ORDERING: Specify rod size, finish and figure number.

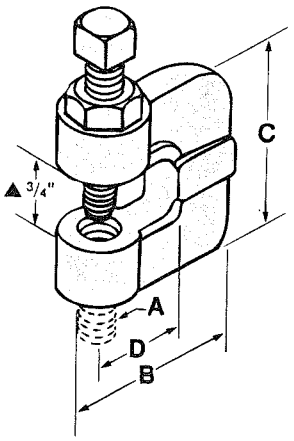
Rod Size A	B	C	D	E▲	Max. Pipe Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.) w/o nut	Wt. Each (in lbs.) with nut
3/8*	2 1/4	2 3/8	7/8	3/4	4	400	.36	.38
1/2*	2 1/4	2 3/8	7/8	3/4	4	500	.36	.38
5/8*	2 3/8	2 3/8	3/4	3/4	5	550	.63	.68
3/4*	2 1/4	2 3/8	3/4	3/4	6	600	.72	.79
7/8	2 1/4	3	1 1/4	1	8	900	1.65	1.83

Note: See MSS SP-69 specs for proper set screw torque values.

▲ Reduced by 1/8" when used in conjunction with Fig. 259 retaining strap.

Fig. 270 & 270-1 MALLEABLE IRON C-CLAMP

Fig. 270 WITH LOCKNUT
Fig. 270-1 WITHOUT LOCKNUT



FUNCTION: Designed for attaching hanger rod to the bottom flange of a beam. The hanger rod should make contact with the beam flange to ensure full engagement.

APPROVALS: Complies with Federal Specification A-A-1192A (Type 23) and Manufacturers' Standardization Society SP-69 (Type 23). (Only for Fig. 270 with locknut)

MATERIAL: Malleable iron with hardened steel cup point set screw

FINISH: Plain or electro-galvanized

ORDERING: Specify rod size, finish and figure number.

Rod Size A	B	C	D	For Pipe Sizes	Max. Rec. Load/lbs.	Wt. Each (in lbs.) w/o nut	Wt. Each (in lbs.) with nut
3/8	1 3/4	1 3/4	5/8	1/2 to 2	400	.30	.33
1/2	1 3/4	1 3/4	5/8	2 1/2 to 3 1/2	400	.38	.39
5/8	2	2	3/4	4 to 5	440	.45	.46
3/4	2	2	3/4	6	500	.51	.52

Note: See MSS SP-69 specs for proper set screw torque values.

▲ Reduced by 1/8" when used in conjunction with Fig. 259 retaining strap.

BEAM CLAMPS

Fig. 259 RETAINING STRAP For Fig. 250 & 270

FUNCTION: Designed for use with Fig. 250, 250-1, 270 and 270-1 to eliminate possible movement of the beam clamp due to vibration.

MATERIAL: Low carbon steel

FINISH: Plain or electro-galvanized

ORDERING: Specify type number, length, finish and figure number.

Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number. Price on request.

Type No.	Material Size	Wt. Each (in lbs.) Length C (inches) 4½	6	8	10	12	14
1	11 ga. x 1	.15	.22	.33	.36	.43	.50
2	11 ga. x 1¼	.21	.28	.36	.45	.52	.59

Note: 1 inch should be added to beam flange width to determine length.

Type No. Selection Chart	Model No.	
Size	250	270
⅜	1	2
½	1	2
⅝	1	2
¾	1	2

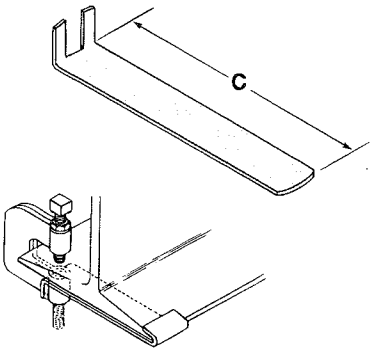


Fig. 290 PURLIN CLAMP

FUNCTION: Designed for use with large-lip rolled steel purlins to eliminate the need to modify steel purlin for standard C-clamp.

APPROVALS: Underwriters' Laboratories listed and Factory Mutual approved.

MATERIAL: Malleable iron with hardened steel cup point set screw.

FINISH: Plain

ORDERING: Specify figure number.

Rod Size	Max. Pipe Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
⅜	4	400	.82

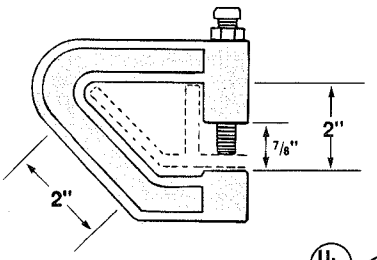


Fig. 359 RETAINING STRAP For Fig. 350 & 360

FUNCTION: Designed for use with Fig. 350, 350-1, 360 and 360-1 to eliminate possible movement of the beam clamp due to vibration.

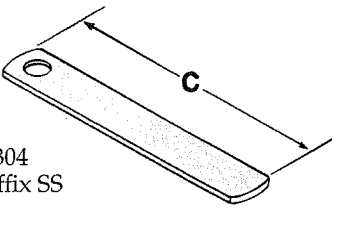
MATERIAL: Low carbon steel

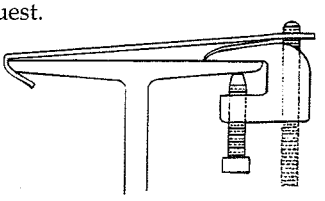
FINISH: Plain or electro-galvanized

ORDERING: Specify rod size, length, finish and figure number.

Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number. Price on request.

Rod Size	Material Size	Wt. Each (in lbs.) Length C (inches) 4½	6	8	10	12	14
⅜	14 ga. x 1	.15	.21	.28	.35	.42	.49
½	14 ga. x 1	.15	.21	.28	.35	.42	.49
⅝	11 ga. x 1¼	.20	.26	.35	.44	.53	.62
¾	11 ga. x 1¼	.20	.26	.35	.44	.53	.62
⅞	11 ga. x 2	.31	.42	.56	.70	.84	.98

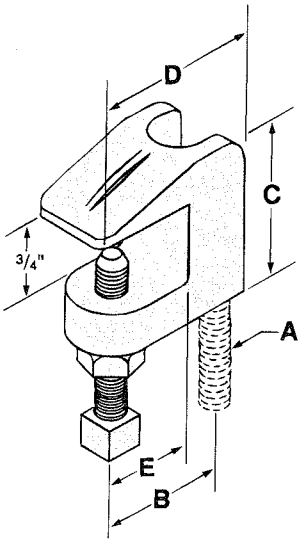




BEAM CLAMPS

Fig. 350 & 350-1 MALLEABLE IRON BEAM CLAMP

Fig. 350 WITH LOCKNUT
Fig. 350-1 WITHOUT LOCKNUT



FUNCTION: Designed for attaching hanger rod to the top flange of a beam or bar joist, where the flange thickness does not exceed ¾ inch. The open U design permits rod adjustment. The universal design of the ⅜ Fig. 350 allows it to be used in an inverted position on the bottom flange of a beam as well.

APPROVALS: Underwriters' Laboratories listed and Factory Mutual approved. Complies with Federal Specification A-A-1192A (Type 19) and Manufacturers' Standardization Society SP-69 (Type 19). When used in an inverted position on the bottom of a beam flange the ⅜ Fig. 350 also complies with Federal Specification A-A-1192A (Type 23) and Manufacturers' Standardization Society SP-69 (Type 23) (Only for Fig. 350 with locknut).

MATERIAL: Malleable iron with hardened steel cup point set screw

FINISH: Plain or electro-galvanized

ORDERING: Specify rod size, finish and figure number.

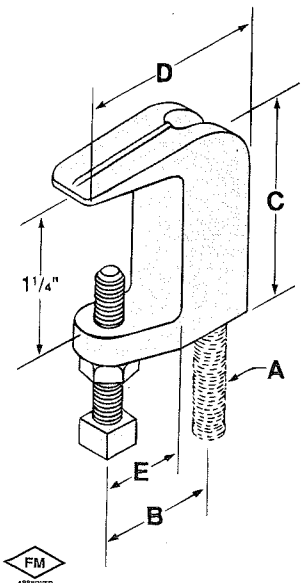
Rod Size A	B	C	D	E	Max. Pipe Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.) w/o nut	Wt. Each (in lbs.) with nut
▲⅜	1	1½	1⅝	½	4	400	.32	.33
½	1	1½	1 11/16	½	8	500	.33	.34
⅝	1 1/16	1½	1⅞	⅝	8	600	.38	.39
¾	1 5/16	1¾	2⅜	⅝	8	800	.59	.63
⅞	1 5/16	1¾	2⅜	⅝	8	1200	.56	.60

Note: *See MSS SP-69 specs for proper set screw torque values.*

▲ Reversible design approved for bottom beam use.

Fig. 360 & 360-1 MALLEABLE IRON WIDE MOUTH BEAM CLAMP

Fig. 360 WITH LOCKNUT
Fig. 360-1 WITHOUT LOCKNUT



FUNCTION: Designed for attaching hanger rod to the top flange of a beam or bar joist, where the flange thickness does not exceed 1¼ inches. The open U design permits rod adjustment.

APPROVALS: Underwriters' Laboratories listed and Factory Mutual approved (⅜ & ½ size only). Complies with Federal Specification A-A-1192A (Type 19) and Manufacturers' Standardization Society SP-69 (Type 19) (Only for Fig. 360 with locknut).

MATERIAL: Malleable iron with hardened steel cup point set screw

FINISH: Plain or electro-galvanized

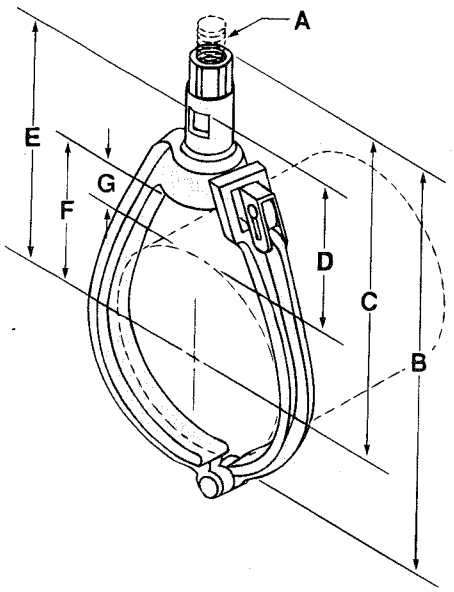
ORDERING: Specify rod size, finish and figure number.

Rod Size A	B	C	D	E	Max. Pipe Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.) w/o nut	Wt. Each (in lbs.) with nut
⅜	1 1/16	1⅞	1⅝	½	4	400	.36	.37
½	1 1/16	1⅞	1⅝	½	4	500	.34	.35
⅝	1⅜	2 5/16	2¼	¾	5	850	.74	.74
¾	1⅜	2⅜	2⅜	¾	6	900	.85	.87

Note: *See MSS SP-69 specs for proper set screw torque values.*

SPLIT RING HANGERS

Fig. 505 ADJUSTABLE SPLIT RING SWIVEL HANGER



FUNCTION: Designed for the suspension of non-insulated stationary pipe lines. The hinged design allows for ease of placement even after the hanger is in place. The adjustable swivel allows for vertical adjustment after pipe is in place.

APPROVALS: Complies with Federal Specification A-A-1192A (Type 6) and Manufacturers' Standardization Society SP-69 (Type 6).

MATERIAL: Malleable iron

FINISH: Plain

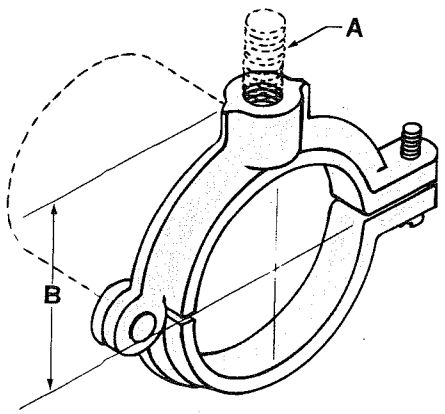
ORDERING: Specify pipe size and figure number.

Pipe Size	Rod Size A	B	C	D	E	F	G	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
3/4	3/8	2 5/8	2 1/8	—	—	15/16	3/8	300	.23
1	3/8	3	2 5/16	—	—	1 1/8	7/16	300	.25
1 1/4	3/8	3 3/8	2 9/16	—	—	1 3/8	9/16	300	.30
1 1/2	3/8	3 3/4	2 3/4	—	—	1 9/16	5/8	300	.32
2	3/8	4 1/4	3 1/16	—	—	1 7/8	11/16	300	.34
2 1/2	1/2	5 3/4	4 5/16	2 1/8	3 9/16	—	—	500	.65
3	1/2	6 3/8	4 5/8	2 1/8	3 7/8	—	—	500	.78
3 1/2	1/2	7	5	2 1/4	4 1/4	—	—	500	.85
4	5/8	8 1/4	6	2 7/8	5 1/4	—	—	900	1.54
5	5/8	9 1/2	6 3/4	3	5 7/8	—	—	900	2.00
6	3/4	11	7 11/16	3 3/8	6 11/16	—	—	1300	3.20
8	7/8	14	9 11/16	4 3/8	8 9/16	—	—	1800	5.00

Note: Sizes 3/4 to 2 do not have a window cutout.

Fig. 508 & 508R HINGED EXTENSION SPLIT CLAMP

Fig. 508 PIPE THREAD
Fig. 508R BOLT THREAD



FUNCTION: Designed for non-insulated stationary pipe lines in either a horizontal or vertical position. The hinged design allows for a quick installation.

APPROVALS: Complies with Federal Specification A-A-1192A (Type 12) and Manufacturers' Standardization Society SP-69 (Type 12).

MATERIAL: Malleable iron

FINISH: Plain or Electro-galvanized

ORDERING: Specify pipe size, finish and figure number.

Pipe Size	A		B	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
	Pipe Thread Fig. 508	Bolt Thread Fig. 508R			
3/8	1/4	3/8	13/16	180	.13
1/2	1/4	3/8	7/8	180	.14
3/4	1/4	3/8	1	180	.16
1	1/4	3/8	1 1/8	180	.18
1 1/4	1/4	3/8	1 5/16	180	.22
1 1/2	1/4	3/8	1 7/16	180	.38
2	1/4	3/8	1 11/16	180	.44
2 1/2	1/2	1/2	2 1/8	300	1.05
3	1/2	1/2	2 7/16	300	1.40
4	1/2	1/2	3	300	1.60

RISER CLAMPS

FUNCTION: Designed for supporting and stabilizing vertical pipe runs. The PVC coating on Fig. 553 protects the pipe from the metal surface of the clamp.

APPROVALS: Complies with Federal Specification A-A-1192A (Type 8) and Manufacturers' Standardization Society SP-69 (Type 8).

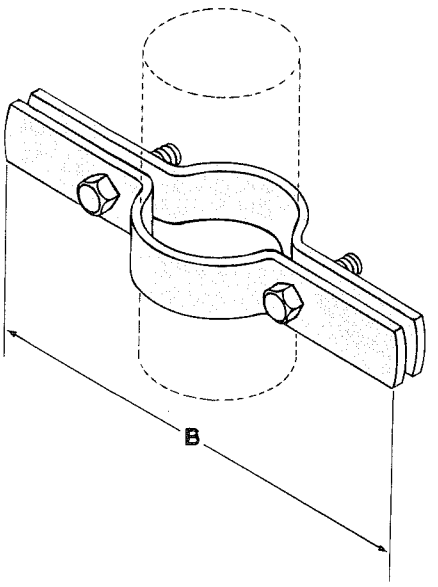
MATERIAL: Low carbon steel

ORDERING: Specify pipe size and figure number.

Fig. 550, 551 & 553 RISER CLAMP

Fig. 550* PLAIN
Fig. 551 ELECTRO-GALVANIZED
Fig. 553 PLAIN WITH PVC COATING

*Available in stainless steel. To order, specify 304 or 316 and add suffix SS to figure number. Price on request.



Pipe Size	B	Bolt Size	Material Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
½	9	⅜ X 1¼	7 ga. X 1¼	220	1.05
¾	9⅜	⅜ X 1¼	7 ga. X 1¼	220	1.10
1	9⅝	⅜ X 1¼	7 ga. X 1¼	220	1.10
1¼	10	⅜ X 1¼	7 ga. X 1¼	250	1.60
1½	10⅜	⅜ X 1¼	7 ga. X 1¼	250	1.60
2	10¾	⅜ X 1¼	7 ga. X 1¼	300	1.70
2½	11¼	⅜ X 1½	3 ga. X 1¼	400	1.90
3	11¾	⅜ X 1½	3 ga. X 1¼	500	1.90
3½	13	⅜ X 1½	3 ga. X 1¼	600	2.30
4	13½	½ X 1¾	3 ga. X 1	750	2.40
5	14½	½ X 1¾	3 ga. X 1½	1500	3.60
6	16	½ X 1¾	3 ga. X 1½	1600	4.00
8	18	⅝ X 2	⅜ X 1½	2500	7.60
10	21½	⅝ X 2	⅜ X 2	2500	11.10
12	24	⅝ X 2½	½ X 2	2700	16.50
14	25	⅝ X 3	½ X 2	2700	17.70
16	26¼	¾ X 3½	⅝ X 2½	2900	30.40
18	28⅜	¾ X 3½	⅝ X 2½	2900	33.30
20	30	¾ X 3½	⅝ X 2½	2900	36.30
24	34¾	⅞ X 3½	⅝ X 3	2900	48.68
30	40¾	⅞ X 3½	⅝ X 3	2900	60.16

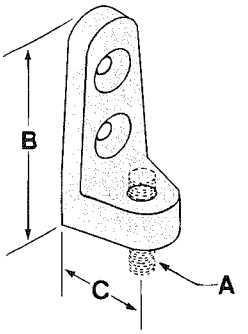
Fig. 905 SIDE BEAM CONNECTOR

FUNCTION: Designed for attaching hanger rod to the side of wooden beams or walls. Normally secured in place with Fig. 48 wood drive screw.

MATERIAL: Malleable iron

ORDERING: Specify rod size and figure number.

Fig. 905 PLAIN
Fig. 905C COPPER FINISH



Rod Size A	B	C	Drive Screw Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
3/8	2 3/16	9/16	#12 X 1½	250	.13
½	2¾	¾	#14 X 1½	480	.25

Fig. 907 & 908 STEEL SIDE BEAM CONNECTOR

FUNCTION: Designed for attaching hanger rod to the sides of steel or wood beams. Fig. 908 is designed to secure with wood drive screws.

APPROVALS: Underwriters' Laboratories listed and Factory Mutual approved. Complies with Federal Specification A-A-1192A (Type 34) and Manufacturers' Standardization Society SP-69 (Type 34).

MATERIAL: Low carbon steel 3 ga. X 1

FINISH: Plain

ORDERING: Specify figure number.

Fig. 907

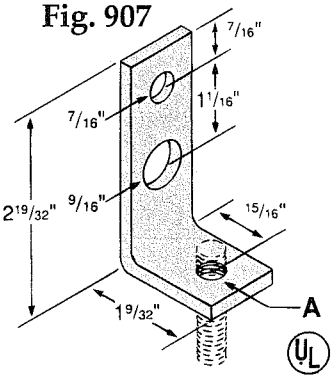
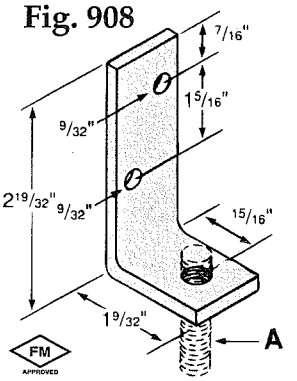


Fig. 908



Bolt Size	Rod Size A	For Pipe Sizes	Bolt or Screw Size	Max. Rec. Load/lbs. With Lag Screw	Max. Rec. Load/lbs. With Bolt to Steel	Max. Rec. Load/lbs. With Wood Drive Screw	Wt. Each (in lbs.)
907	3/8	½ to 2	3/8	400	620	–	.13
907	3/8	2½ to 4	½	560	620	–	.13
908	3/8	½ to 2	16 X 2	–	–	400	.13

Fig. 910 REVERSIBLE ANGLE BRACKET

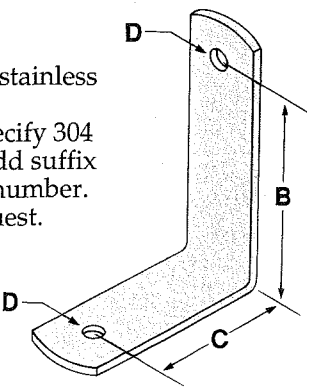
FUNCTION: Designed to support pipe at various distances from a wall or column.

MATERIAL: Low carbon steel

FINISH: Plain

ORDERING: Specify size number and figure number.

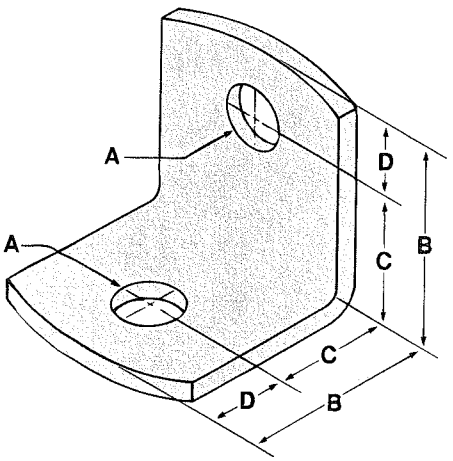
Available in stainless steel.
To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.



Size No	B	C	Hole Size D	Material Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
1	3	2	7/16	3 ga. X 1¼	180	.43
2	4	3	7/16	3 ga. X 1¼	180	.58
3	3	2	9/16	3/8 X 1½	390	1.00
4	4	3	9/16	3/8 X 1½	390	1.25

Fig.920 SIDE BEAM ANGLE BRACKET

Available in stainless steel.
To order, specify 304 or 316 and add suffix SS to figure number.
Price on request.



FUNCTION: Designed for use with wood, steel or concrete beams to provide a means for supporting hanger rod. When used on steel beams Fig. 920 can be welded or bolted in place.

APPROVALS: Complies with Federal Specification A-A-1192A (Type 34) and Manufacturers' Standardization Society SP-69 (Type 34).

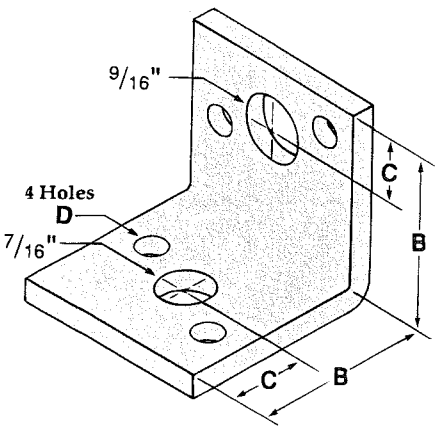
MATERIAL: Low carbon steel

FINISH: Plain or Electro-galvanized

ORDERING: Specify rod size, finish and figure number.

Rod Size A	For Pipe Size	B	C	D	Material Size	Max. Rec. Load/lbs.		Wt. Each (in lbs.)
						Lag Screw	Bolted to Steel	
3/8	1/2 to 2	2 1/8	1 1/2	5/8	3 ga. X 2	390	580	.52
1/2	2 1/2 to 3 1/2	2 1/8	1 1/2	5/8	3 ga. X 2	640	960	.50
5/8	4 to 5	2 1/2	1 1/2	1	3/8 X 2	760	1500	.75
3/4	6	2 1/2	1 1/2	1	3/8 X 2	830	2500	.73
7/8	8 to 12	3 1/4	2 1/4	1	1/2 X 2	830	3600	1.38

Fig. 925 REVERSIBLE SIDE BEAM ANGLE BRACKET



FUNCTION: Designed for attaching hanger rod to the side of beams or walls. Fig. 925 can accommodate either 3/8 or 1/2 inch rod.

MATERIAL: Low carbon steel

FINISH: Plain or Electro-galvanized

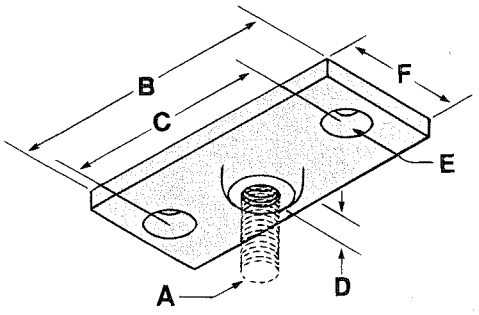
ORDERING: Specify finish and figure number.

For Rod Size	B	C	D	Material Size	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
3/8 or 1/2	2	13/16	9/32	3 ga. X 2	500	.50

CEILING FLANGE & CONCRETE INSERT

Fig. 940, 940-1, 941, 941-1 & 942 CEILING FLANGE

Fig. 940 PLAIN WITH BOLT THREAD
Fig. 940-1 PLAIN WITH PIPE THREAD
Fig. 941 ELECTRO-GALVANIZED WITH BOLT THREAD
Fig. 941-1 ELECTRO-GALVANIZED WITH PIPE THREAD
Fig. 942 COPPER PLATED WITH BOLT THREAD



FUNCTION: Designed to provide a means for attaching hanger rod to wood beams or ceilings.

MATERIAL: Malleable iron

ORDERING: Specify thread size and figure number.

Note: ⅜" furnished in steel design only.

A								
Bolt Thread	Pipe Thread	B	C	D	E	F	Max. Rec. Load/lbs.	Wt. Each (in lbs.)
—	¼	2¾	2	½	¼	1¼	180	.18
⅜	—	2¾	2	½	¼	1¼	180	.18
½	—	2¾	2	½	¼	1¼	180	.18

Fig. 950, 951, 950N & 951N CONCRETE INSERT

Fig. 950 PLAIN
Fig. 951 ELECTRO-GALVANIZED
Fig. 950N PLAIN INSERT NUT
Fig. 951N ELECTRO-GALVANIZED INSERT NUT

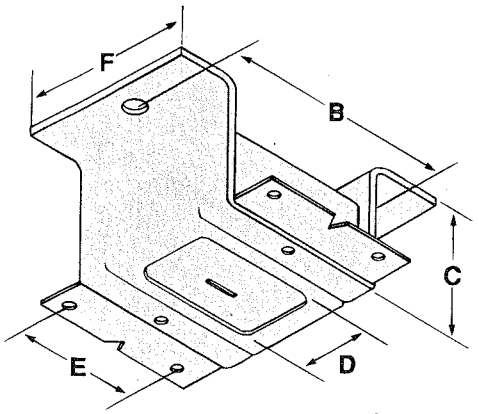


Fig. 950*

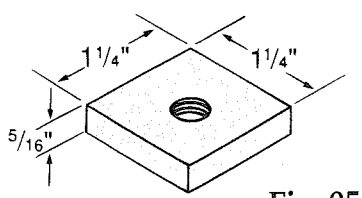


Fig. 950N

FUNCTION: Designed to be embedded in concrete to provide a means of suspending pipe from ceilings. The insert is held in place by nailing it to the forms, until the concrete is poured. The insert comes with a snap-out plug to keep the inner housing clean during pouring of the concrete. After the concrete has set, the plug is removed, exposing the inner housing. The rod should be tightened until it touches the top of the insert, but should not be forced further to avoid damage to the insert.

APPROVALS: Complies with Federal Specification A-A-1192A (Type 18) and Manufacturers' Standardization Society SP-69 (Type 18).

MATERIAL: Low carbon steel

ORDERING: Specify figure number. If insert nut is required order separately, include the rod size and figure number.

Rod Sizes	B	C	D	E	F	Max. Rec. Load/lbs.	Wt. Each (in lbs.)	
							Insert	Nut
¼	3⅛	1⅝	⅞	1½	2	240	.44	.08
⅜	3⅛	1⅝	⅞	1½	2	600	.44	.10
½	3⅛	1⅝	⅞	1½	2	600	.44	.11
⅝	3⅛	1⅝	⅞	1½	2	600	.44	.14
¾	3⅛	1⅝	⅞	1½	2	600	.44	.16
⅞	3⅛	1⅝	⅞	1½	2	600	.44	.17

*Fig. 950 maximum rod size is ¾

ITW Buildex

SAMMYS®

2012 PRODUCT CATALOG

www.itwbuildex.com 800-BUILDEX

TABLE OF CONTENTS

Warranty • Disclaimer of Warranty

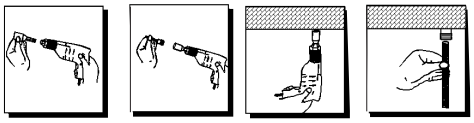
Proper fastener connection design takes in to account where and how fasteners are used. Allowance for special characteristics in materials, differences in materials, differences in types of materials being joined, unique or unusual environmental service or installation conditions and the safety factors required by anticipating normal or short term loading conditions must be considered. Due to possible differences in specifications, applications, and interpretation of results, purchasers and specifiers must make their own evaluation of the products, to determine the suitability of these products for intended use. All warranties of Buildex products, expressed or implied, including the warranties of merchantabilty and fitness for particular purposes are specifically excluded except for the following: Buildex will repair or replace any product which, within twelve months after sale by Buildex or its distributors, is found by Buildex to be defective in material or workmanship - normal wear and tear accepted. This is the sole warranty of Buildex and the sole remedy available to distributor or buyer. Buildex shall not be liable for any injury, loss or damage, direct, indirect, or consequential, arising out of the use of, or the inability to use, any Buildex product.

INSTALLATION INSTRUCTIONS FOR WOOD & STEEL

INSTALLATION STEPS - VERTICAL INTO WOOD & STEEL:

1. *Insert the appropriate nut driver into a 3/8" or 1/2" portable drill.*
2. *Insert the SAMMYS® into the #14 (black) nut driver (p/n 8113910). Drill should be in a vertical position.*
3. *Push the face of the nut driver tight to the member. Begin installation when the nut driver spins freely on the SAMMYS, stop drill and remove.*
4. *The SAMMYS is now ready to receive 1/4", 3/8", 1/2" or metric all thread rod, bolt stock. (The 1/2" requires the #14SW red nut driver)*

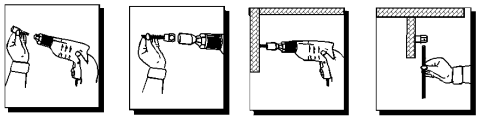
Note: *When installing DSTR, follow the above instructions, then add retainer nut and torque to 20 foot lbs. for maximumpullout in purlin steel.*



INSTALLATION STEPS - HORIZONTAL INTO WOOD & STEEL:

1. *Insert the appropriate nut driver into a 3/8" or 1/2" portable drill.*
2. *Insert the SAMMYS into the #14SW (red) nut driver (p/n 8114910). With drill unit in a horizontal position and at a right angle to the structural member, begin installation.*
3. *When the nut driver spins freely on the SAMMYS, stop the drill and remove.*
4. *The unit is now ready to receive 1/4", 3/8", M10, M8 or metric all thread rod or bolt stock.*

Note: *When installing SWDR, follow the above instructions, then add retainer nut and torque to 20 foot lbs. for maximum pullout in purlin steel.*



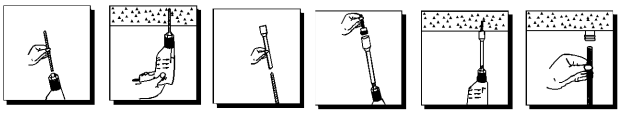
INSTALLATION INSTRUCTIONS FOR CONCRETE

INSTALLATION STEPS - VERTICAL INTO CONCRETE:

1. *Using an SDS 250 carbide tip bit or a HEX RECEIVER with a #250 carbide tip bit, pre-drill the concrete member to a depth of 2" with a hammer/rotary hammer drill set on impact mode.*
2. *After pre-drilling has been completed, install the SLEEVE TOOL over the bit (the bit should remain in the drill), and insert the #14 (black) nut driver (p/n 8113910) into the opposite end (see Vertical Installation note above).*
3. *Insert the CST screw into the nut driver.*
4. *Place tip of screw into the pre-drilled hole, turn impact/drill unit to drill mode and begin insertion. When the nut driver spins freely on the CST screw, installation is complete. Stop and remove drill.*
5. *The concrete screw is ready to receive 1/4", 3/8", 1/2", or metric all thread rod or bolt stock. (#14SW red nut driver used with 1/2" screw)*

Note: *Use a 1200 maximum RPM drill for installation.*

Note: *Do not install concrete screws while the drill unit is in impact mode — doing so will destroy the pullout factor of the screw.*

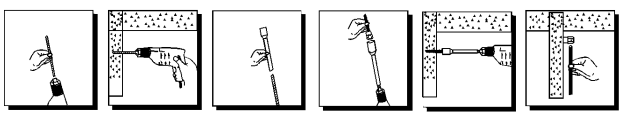


INSTALLATION STEPS - HORIZONTAL INTO CONCRETE:

1. *Using an SDS 250 carbide tip bit or a HEX RECEIVER with a #250 carbide tip bit, pre-drill the concrete member to a depth of 2" with a hammer/rotary hammer drill set on impact mode.*
2. *After pre-drilling has been completed, install the SLEEVE TOOL over the bit (the bit should remain in the drill), and insert the #14SW (red) nut driver (p/n 8114910) into the opposite end.*
3. *Insert the SWC screw into the nut driver.*
4. *Place tip of screw into the pre-drilled hole, turn impact/drill unit to drill mode and begin insertion. When the nut driver spins free on the SWC screw, installation is complete. Stop and remove drill.*
5. *The SWC screw is ready to receive 1/4", 3/8" or metric all thread rod or bolt stock.*

Note: *Use a 1200 maximum RPM drill for installation.*

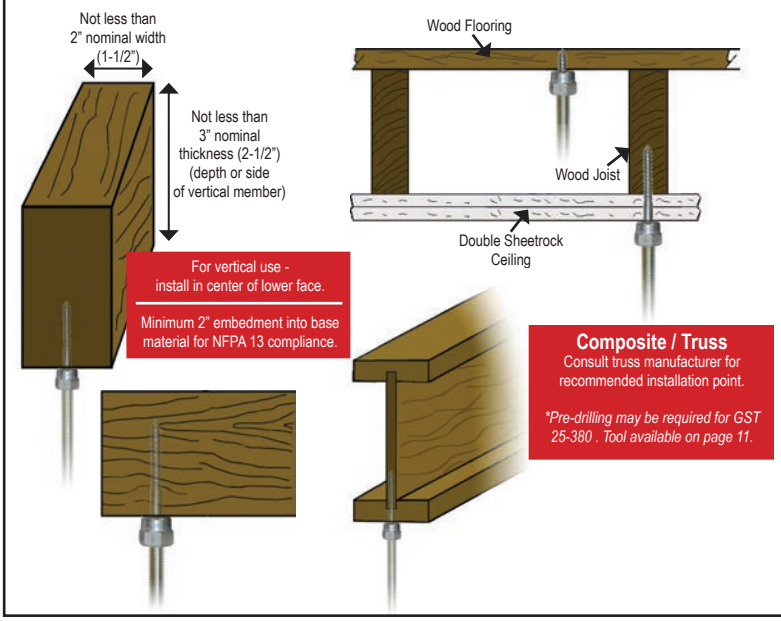
Note: *Do not install concrete screws while the drill unit is in impact mode — doing so will destroy the pullout factor of the fastener.*



SPECIAL NUT DRIVER SYSTEM: The nut drivers were designed with a unique spin-off feature which provides a fast and safe installation each time. When the face of the driver comes into contact with the material you are installing into, continue drilling until nut driver spins free. Installation is then complete. Warranty requires the use of the appropriate nut driver for installations.

SAMMYS® FOR WOOD - Vertical Application

Application



Product Features

- No pre-drilling required.
- Quick to install using the Sammy Nut Driver with an 18V cordless drill/driver.
- Saves time from traditional methods.
- Reduces installation costs.
- Manufactured in the U.S.A.

Watch a video demonstration at www.itwbuildex.com

Approvals	Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)	UL Test Load (lbs)	FM Test Load (lbs)	Box Qty	Case Qty
VERTICAL MOUNT									
	1/4"	8002957	GST 100	1/4 x 1"	210 (7/16" OSB) 670 (3/4" Ply)			25	125
	1/4"	8003957	GST 200	1/4 x 2"	1760 (Fir)			25	125
UL	3/8"	8007957	GST 10	1/4 x 1"	210 (7/16" OSB) 670 (3/4" Ply)	300		25	125
UL FM	3/8"	8008957	GST 20	1/4 x 2"	1760 (Fir)	850	1475	25	125
UL	3/8"	8068925	GST 20-SS	1/4 x 2"	1760 (Fir)	850		25	125
UL	3/8"	8009925	GST 25-380	3/8 x 2-1/2"	2113 (Fir)	1500		25	125
UL FM	3/8"	8010957	GST 30	1/4 x 3"	2060 (Fir)	1500	1475	25	125
	3/8"	8069925	GST 30-SS	1/4 x 3"	2060 (Fir)			25	125
	1/2"	8013925	GST 2	1/4 x 2"	1760 (Fir)			25	125
	1/2"	8015925	GST 3	1/4 x 3"	2275 (Fir)			25	125

#14 Black Nut Driver Part # 8113910

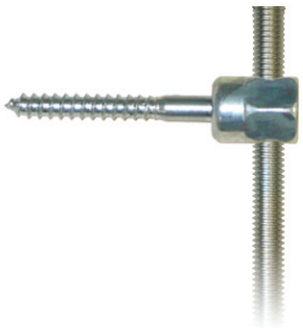
#14 SW Red Nut Driver Part # 8114910

MANUFACTURED U.S.A.

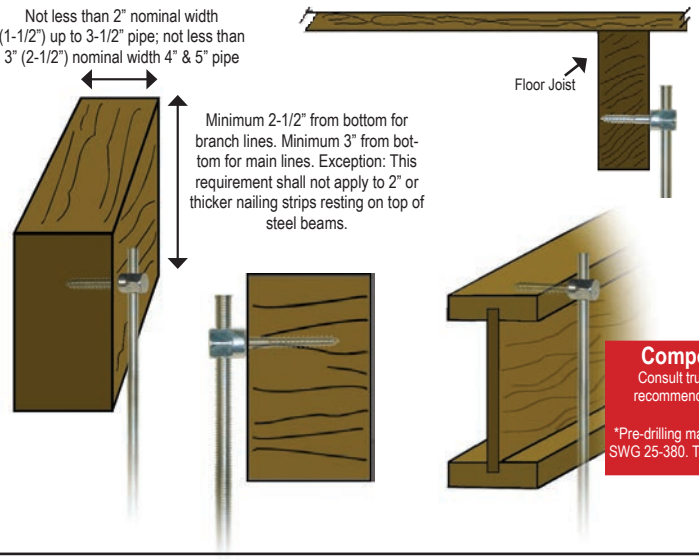
RoHS Compliant

SPECIAL NUT DRIVER SYSTEM: The nut drivers were designed with a unique spin-off feature which provides a fast and safe installation each time. When the face of the driver comes into contact with the material you are installing into, continue drilling until nut driver spins free. Installation is then complete. Warranty requires the use of the appropriate nut driver for installations.

SIDEWINDER® FOR WOOD - Horizontal Application



Application



Composite / Truss
Consult truss manufacturer for recommended installation point.

*Pre-drilling may be required for Model SWG 25-380. Tool available on page 11.

Watch a video demonstration at www.itwbuildex.com

Product Features

- No pre-drilling required.
- Quick to install using the Sammy Nut Driver with an 18V cordless drill/driver.
- Saves time from traditional methods.
- Reduces installation costs.
- Manufactured in the U.S.A.

Approvals	Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)	UL Test Load (lbs)	Box Qty	Case Qty
HORIZONTAL MOUNT								
	1/4"	8019957	SWG 200	1/4 x 2"	1725 (Fir)		25	125
	3/8"	8020957	SWG 10	1/4 x 1"	622 (Fir)	300	25	125
	3/8"	8021957	SWG 20	1/4 x 2"	1725 (Fir)	1050	25	125
	3/8"	8073925	SWG 20-SS	1/4 x 2"	1725 (Fir)	850	25	125
	3/8"*	8022925	SWG 25-380	3/8 x 2-1/2"	2249 (Fir)	1500	25	125
	3/8"	8023925	SWG 30	1/4 x 3"	1884 (Fir)		25	125

#14 SW Red Nut Driver Part # 8114910

* May require pre-drilling; consult joist manufacturer.

SAMMYS SWIVEL HEAD™ FOR WOOD - Swivel Application

Application

Product Features

- Eliminates distortion of threaded rod.
- Accommodates up to 3 ½" x 12 pitch roof.
- Allows 17° deflection from vertical.
- Saves time from traditional methods.
- Reduces installation costs.
- Manufactured in the U.S.A.

Approvals	Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)	UL Test Load (lbs)	FM Test Load (lbs)	Min Thickness	Box Qty	Case Qty
SWIVEL MOUNT										
	3/8"	8139957	SH-GST 20	1/4 x 2"	1257 (Fir)	1050	1475		25	125
	3/8"*	8269957	SH-GST/CST 20	5/16 x 1-3/4"	1903 Dim. Lumber 1406 @ 45°off vertical Dim. Lumber	1500 850 @ 45°			25	125
	1/2"	8303957	SH-GST/CST 2.0	5/16 x 1-3/4"	903 Dim. Lumber 1406 @ 45°off vertical Dim. Lumber				25	125

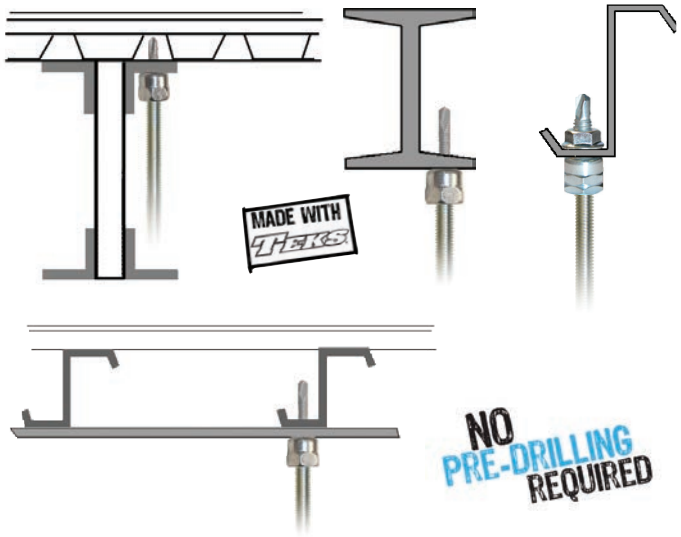
#14 Black Nut Driver Part # 8113910

#14 SH Orange Nut Driver Part # 8273910

* May require pre-drilling; consult joist manufacturer.

SAMMYS® FOR STEEL - Vertical Application

Application



Product Features

- Made with Teks® self-drilling fasteners - no pre-drilling required.
- Installs into steel range from 20 gauge – 1/2" thicknesses.
- Saves time from traditional methods.
- Reduces installation costs.
- Quick to install using the Sammys Nut Driver with an 18V cordless drill/driver.
- A standard screwgun with a depth sensitive nosepiece should be used to install Teks. For optimal fastener performance, the screwgun should be a minimum of 6 amps and have an RPM range of 0-2500.
- Manufactured in the U.S.A.

Watch a video demonstration at www.itwbuildex.com

Approvals	Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)	UL Test Load (lbs)	FM Test Load (lbs)	Min Thick	Max Thick	Box Qty	Case Qty
VERTICAL MOUNT											
	1/4"	8024957	DSTR 100 *	1/4-20 x 1" TEKS 3	1510 (20 ga.)			.036"-20 ga	3/16"	25	125
	1/4"	8025957	DST 100	1/4-14 x 1" TEKS 3	446 (20 ga.)			.036"-20 ga	3/16"	25	125
	1/4"	8026957	DST 150	1/4-14 x 1-1/2" TEKS 3	970 (16 ga.)			.036"-20 ga	3/16"	25	125
	1/4"	8027957	DST 200	1/4-14 x 2" TEKS 3	446 (20 ga.)			.036"-20 ga	3/16"	25	125
	1/4"	8030957	TEK 500	12-24 x 1-1/2" TEKS 5	3125 (3/16")			.188"-3/16"	1/2"	25	125
UL FM	3/8"	8038957	DSTR 1 *	1/4-20 x 1" TEKS 3	1510 (20 ga.)	1500	1475	.036"-20 ga	3/16"	25	125
UL FM	3/8"	8037957	DSTR 1-1/2 *	12-24 x 1-1/2" TEKS 5	1510 (3/16")	1500	1475	.060"-16 ga.	1/2"	25	125
UL FM	3/8"	8039957	DSTR 516 *	5/16-18 x 1-1/4" TEKS 3	2200 (20 ga.)	1500	1475	.036"-20 ga	3/16"	25	125
	3/8"	8040957	DST 10	1/4-14 x 1" TEKS 3	446 (20 ga.) 970 (16 ga.)			.036"-20 ga	3/16"	25	125
	3/8"	8077925	DST 10-SS	1/4-14 x 1" TEKS 3	446 (20 ga.) 970 (16 ga.)			.036"-20 ga	3/16"	25	125
	3/8"	8041957	DST 15	1/4-14 x 1-1/2" TEKS 3	446 (20 ga.) 970 (16 ga.)			.036"-20 ga	3/16"	25	125
	3/8"	8078925	DST 15-SS	1/4-14 x 1-1/2" TEKS 3	446 (20 ga.) 970 (16 ga.)			.036"-20 ga	3/16"	25	125
	3/8"	8042957	DST 20	1/4-14 x 2" TEKS 3	446 (20 ga.) 970 (16 ga.)			.036"-20 ga	3/16"	25	125
	3/8"	8044957	DST 30	1/4-14 x 3" TEKS 3	446 (20 ga.) 970 (16 ga.)			.036"-20 ga	3/16"	25	125
UL FM	3/8"	8045957	DST 516	5/16-18 x 1-1/4" TEKS 3	1500 (3/16")	1500	1475	.125"-1/8"	3/16"	25	125
UL FM	3/8"	8046957	TEK 50	12-24 x 1-1/2" TEKS 5	3125 (3/16")	1500	1475	.250"-1/4"	1/2"	25	125
	1/2"	8031925	DST 2.0	1/4-14 x 2" TEKS 3	446 (20 ga.) 970 (16 ga.)			.188"-3/16"	1/4"	25	125
	1/2"	8033925	DSTR 1.0 *	1/4-20 x 1" TEKS 3	1510 (20 ga.)			.036"-20 ga	3/16"	25	125
	1/2"	8034925	DSTR 5.16 *	5/16-18 x 1-1/4" TEKS 3	2220 (20 ga.)			.036"-20 ga	3/16"	25	125
	1/2"	8035925	DST 5.16	5/16-18 x 1-1/4" TEKS 3	1500 (3/16")			.125"-1/8"	3/16"	25	125
	1/2"	8036925	TEK 5.0	12-24 x 1-1/2" TEKS 5	3125 (3/16")			.188"-3/16"	1/2"	25	125

*Includes retaining nut

#14 Black Nut Driver Part # 8113910

#14 SW Red Nut Driver Part # 8114910

MANUFACTURED U.S.A.

RoHS Compliant

SPECIAL NUT DRIVER SYSTEM: The nut drivers were designed with a unique spin-off feature which provides a fast and safe installation each time. When the face of the driver comes into contact with the material you are installing into, continue drilling until nut driver spins free. Installation is then complete. Warranty requires the use of the appropriate nut driver for installations.

SIDEWINDER® FOR STEEL - Horizontal Application

Application

Product Features

- Made with Teks® self-drilling fasteners - no pre-drilling required.
- Installs into steel range from 20 gauge – 1/2" thicknesses.
- A standard screwgun with a depth sensitive nosepiece should be used to install Teks. For optimal fastener performance, the screwgun should be a minimum of 6 amps and have an RPM range of 0-2500.
- Saves time from traditional methods.
- Reduces installation costs.
- Quick to install using the Sammys Nut Driver with an 18V cordless drill/driver.
- Manufactured in the U.S.A.

Watch a video demonstration at www.itwbuildex.com

Approvals	Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)	UL Test Load (lbs)	FM Test Load (lbs)	Min Thickness	Max Thickness	Box Qty	Case Qty
HORIZONTAL MOUNT											
	1/4"	8047957	SWD 100	1/4-14 x 1" TEKS 3	1477 (16 ga.)			.060"-16 ga	3/16"	25	125
	1/4"	8049957	SWDR 100 *	1/4-20 x 1" TEKS 3	1900 (20 ga.)			.036"-20 ga	3/16"	25	125
	3/8"	8050957	SWD 10	1/4-14 x 1" TEKS 3	1477 (16 ga.)			.060"-16 ga	3/16"	25	125
	3/8"	8080925	SWD 10-SS	1/4-14 x 1" TEKS 3	1477 (16 ga.)			.060"-16 ga	3/16"	25	125
	3/8"	8052957	SWD 20	1/4-14 x 2" TEKS 3	1477 (16 ga.)			.060"-16 ga	3/16"	25	125
UL FM	3/8"	8055957	SWDR 1 *	1/4-20 x 1" TEKS 3	1900 (20 ga.)	1500	1475	.036"-20 ga	3/16"	25	125
UL FM	3/8"	8054957	SWDR 1-1/2 *	12-24 x 1-1/2" TEKS 5	2375 (3/16")	1500	1475	.188"-3/16"	1/2"	25	125
UL FM	3/8"	8056957	SWDR 516 *	5/16-18 x 1-1/4" TEKS 3	2480 (20 ga.)	1500	1475	.036"-20 ga	3/16"	25	125
	3/8"	8057957	SWT 15	12-24 x 1-1/2" TEKS 5	2375 (3/16")			.188"-3/16"	1/2"	25	125

#14 SW Red Nut Driver Part # 8114910

*Includes retaining nut

SAMMYS SWIVEL HEAD™ FOR STEEL - Swivel Application

Application

Product Features

- Eliminates distortion of threaded rod in sloped roof applications.
- Accommodates 3-1/2 x 12 pitch.
- Installs into angled z-purlin; allows threaded rod to hang plumb.
- Allows 17° deflection from vertical.
- Manufactured in the U.S.A.

Watch a video demonstration at www.itwbuildex.com

Approvals	Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)	UL Test Load (lbs)	FM Test Load (lbs)	Min Thick	Max Thick	Box Qty	Case Qty
SWIVEL MOUNT											
UL FM	3/8"	8137957	SH-DSTR 1*	1/4-20 X 1" TEKS 3	3220 (3/16")	1500	1475	.035"	3/16"	25	125
UL	3/8"	8268957	SH-TEK 50	12-24 x 1-3/4" TEKS 5	2368 (1/2" steel Vertical) 1306 (45° off Vertical) 2281 (3/16" HSS) 1585 (3/16" HSS 45° off Vertical)	1500 (Vertical) 850 (45° off Vertical)	4" 2-1/2"	3/16"	1/2"	25	125
	1/2"	8270957	SH-TEK 5.0	12-24 x 1-3/4" TEKS 5	2368 (1/2" steel Vertical) 1306 (45° off Vertical) 2281 (3/16" HSS) 1585 (3/16" HSS 45° off Vertical)			3/16"	1/2"	25	125

#14 Black Nut Driver Part # 8113910

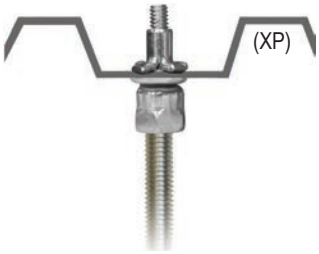
#14 SH Orange Nut Driver Part # 8273910

*Does not comply with ROHS requirements / Includes retaining nut

SAMMY X-PRESS® *Installs into Metal Deck, Purlin, or Tubular Steel*

SAMMY X-PRESS® - Vertical Application

Application

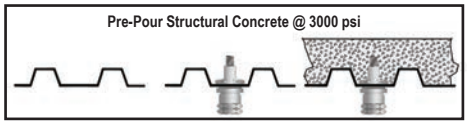


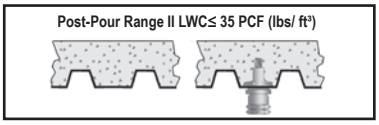
Product Features

- The ***Sammy X-Press*** expands to provide direct vertical attachment in:
  - light gauge steel deck or purlin (22 ga. - 1/8").
- Installs in seconds with Sammy X-Press It® Tool, saving time & installation costs.
- Use in applications where access to the back of the installed fastener is prohibited. ie. metal roof deck, tubular steel, or vapor barrier fabric.
- Less jobsite material needed.
- No retaining nut required.
- Provides design flexibility.
- Manufactured in the U.S.A.

Watch a video demonstration at www.itwbuildex.com

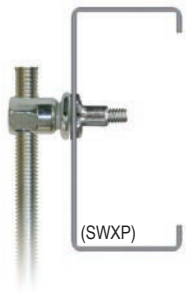
Approvals	Rod Size	Part Number	Model	Description	Ultimate Pullout (lbs)	UL Test Load (lbs)	UL Min Thick	FM Test Load (lbs)	FM Min Thick	Max Thick	Box Qty	Case Qty	Application
VERTICAL MOUNT													
UL	1/4"	8181922	XP 200	Sammy X-Press 200	1146 (22 ga)	185 (Luminaire) 250 (Luminaire)	.027" .056"			.125"	25	125	Metal Deck
UL FM	3/8"	8150922	XP 20	Sammy X-Press 20	1146 (22 ga)	850 (2½" Pipe) 185 (Luminaire) 250 (Luminaire) 283 (Conduit & Cable)	.027" .027" .056" .029"	940 (2" Pipe) 1475 (4" Pipe)	.029" .104"	.125"	25	125	Metal Deck
UL FM	3/8"	8153922	XP 35	Sammy X-Press 35	1783 (16 ga)	1500 (4" Pipe) 185 (Luminaire) 250 (Luminaire) 416 (Conduit & Cable)	.060" .029" .056" .059"	940 (2" Pipe) 1475 (4" Pipe)	.029" .104"	.125"	25	125	Purlin
UL	3/8"	8150922	XP 20	Sammy X-Press 20	1146 (22 ga)	850 (2½ Pipe)		Pre-Pour Structural Concrete@ 3000 psi Post-Pour Range II LWC≤ 35 PCF (lbs/ft³)			25	125	Metal Deck (Pre-Pour) Metal Deck (Post-Pour)





SAMMY X-PRESS SIDEWINDER™ - Horizontal Application

Application



Product Features

- The ***Sammy X-Press Sidewinder*** expands to provide horizontal attachment in:
  - 16 ga - 3/16" steel - purlin, tubular steel.
- Installs in seconds with Sammy X-Press It® Tool, saving time & installation costs.
- Use in applications where access to the back of the installed fastener is prohibited; ie. metal roof deck, tubular steel, or vapor barrier fabric.
- Less jobsite material needed.
- No retaining nut required.
- Provides design flexibility.
- Manufactured in the U.S.A.

Watch a video demonstration at www.itwbuildex.com

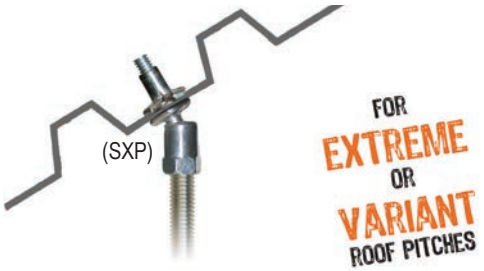
Approvals	Rod Size	Part Number	Model	Description	Ultimate Pullout (lbs)	UL Test Load (lbs)	UL Min Thick	FM Test Load (lbs)	Max Thick	Box Qty	Case Qty	Application
HORIZONTAL MOUNT												
UL	3/8"	8293957	SWXP 35	Sidewinder X-Press 35	1798 (16 ga)	1250 (3½" Pipe) 80 (Luminaire) 416 (Conduit & Cable)	.059"		.125"	25	125	Purlin

MANUFACTURED U.S.A.

RoHS Compliant

SAMMY X-PRESS SWIVEL™ - Swivel Application

Application



Product Features

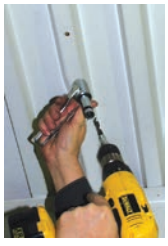
- The ***Sammy X-Press Swivel*** allows you to hang plumb in extreme roof pitches:
  - 89° in z-purlin
  - 45° in metal deck for 12/12 pitch
- Installs in seconds with Sammy X-Press It® Tool, saving time & installation costs.
- Use in applications where access to the back of the installed fastener is prohibited. ie. metal roof deck, tubular steel, or vapor barrier fabric.
- Less jobsite material needed.
- No retaining nut required.
- Provides design flexibility.
- Manufactured in the U.S.A.

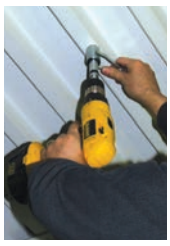
Watch a video demonstration at www.itwbuildex.com

Approvals	Rod Size	Part Number	Model	Description	Ultimate Pullout (lbs)	UL Test Load (lbs)	UL Min Thick	FM Test Load (lbs)	FM Min Thick	Max Thick	Box Qty	Case Qty	Application
SWIVEL MOUNT													
UL FM	3/8"	8294922	SXP 20	Swivel X-Press 20	1061 (22 ga Vert) 829 (45° Off Vert)	750 (2" Pipe) 170 Vertical (Luminaire) 80 @ 45° (Luminaire) 283 Vertical (Conduit & Cable) 233 @ 45° (Conduit & Cable)	.029"	635 (2" Pipe)	.029"	.125"	25	125	Metal Deck
UL FM	3/8"	8295922	SXP 35	Swivel X-Press 35	1675 (16 ga Vert) 1558 (89° Off Vert)	1250 (3-1/2" Pipe) 250 Vertical (Luminaire) 80 @ 90° (Luminaire) 500 Vertical (Conduit & Cable) 333 @ 89° (Conduit & Cable)	.059"	635 (2" Pipe)	.029"	.125"	25	125	Purlin
	1/2"	8272957	SXP 2.0	Swivel X-Press 2.0	1061 (22 ga Vert) 829 (45° Off Vert)		.027"	.125"			25	125	Metal Deck
	1/2"	8271957	SXP 3.5	Swivel X-Press 3.5	1675 (16 ga Vert) 1558 (89° Off Vert)		.060"	.125"			25	125	Purlin

SAMMY X-PRESS IT® Installation Tool

Application



Product Features

- The ***Sammy X-Press*** expands to provide direct vertical attachment in:
  - metal deck (22-16 gauge)
  - z-purlin (18-16 gauge)
- Manufactured in the U.S.A.

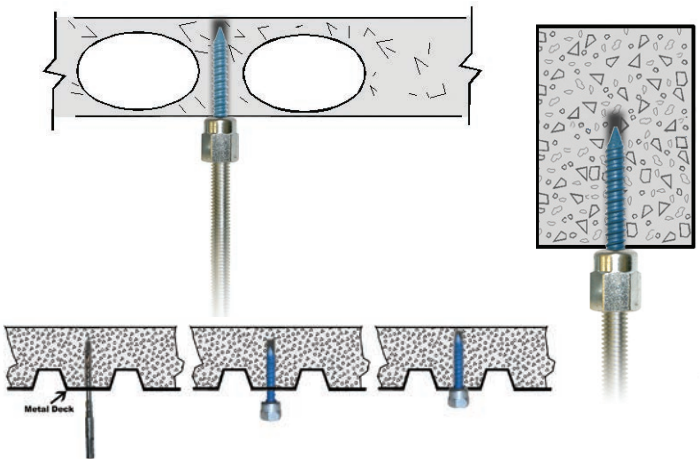
Watch a video demonstration at www.itwbuildex.com

Part Number	Model	Description	Qty
8194910	UXPIT*	Universal X-Press It Tool	1
8152910	XPDB	25/64" Drill Bit	1

*Tool Includes: Sleeve, Bit Receiver, Hex Wrench, and 25/64" Drill Bit.

SAMMYS® FOR CONCRETE - Vertical Application

Application



Product Features

- Easy two step process (Drill hole & drive Sammys concrete anchor).
- ¼" pre-drilled pilot hole required.
- Concrete Installation Tool available for a one tool installation process.
- Manufactured in the U.S.A.

Watch a video demonstration at www.itwbuildex.com

Approvals	Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)*	FM Test Load (lbs)	Box Qty	Case Qty
VERTICAL MOUNT								
	1/4"	8058957	CST 200	5/16 x 1-3/4"	2400		25	125
FM	3/8"	8059957	CST 20	5/16 x 1-3/4"	2400	1475	25	125
	3/8"	8145925	CST 20-SS	5/16 x 1-3/4"	2400		25	125
	1/2"	8060925	CST 2	5/16 x 1-3/4"	2400		25	125

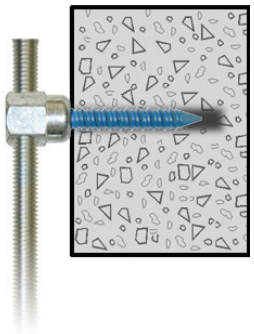
#14 Black Nut Driver Part # 8113910

#14SW Red Nut Driver Part # 8114910

* Tested in 3000 PSI concrete

SIDEWINDER® FOR CONCRETE - Horizontal Application

Application



Product Features

- Easy two step process (Drill hole & drive Sammys concrete anchor).
- ¼" pre-drilled pilot hole required.
- Concrete Installation Tool available for a one tool installation process.
- Manufactured in the U.S.A.

Watch a video demonstration at www.itwbuildex.com

Approvals	Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)*	FM Test Load (lbs)	Box Qty	Case Qty
HORIZONTAL MOUNT								
	1/4"	8062957	SWC 200	5/16 x 1-3/4"	2450		25	125
FM	3/8"	8061957	SWC 20	5/16 x 1-3/4"	2450	1475	25	125

#14SW Red Nut Driver Part # 8114910

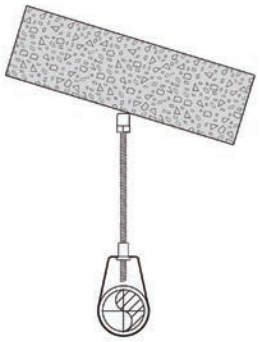
* Tested in 3000 PSI concrete

MANUFACTURED U.S.A.

SPECIAL NUT DRIVER SYSTEM: The nut drivers were designed with a unique spin-off feature which provides a fast and safe installation each time. When the face of the driver comes into contact with the material you are installing into, continue drilling until nut driver spins free. Installation is then complete. Warranty requires the use of the appropriate nut driver for installations.

SAMMYS SWIVEL HEAD™ FOR CONCRETE - Swivel Application

Application



Product Features

- Installs vertically and swivels up to 89° in wood & concrete structures.
- Eliminates distortion of threaded rod.
- 1/4" pre-drilled pilot hole required.
- Concrete installation tool available for a one piece installation process.
- Manufactured in the U.S.A.

Approvals	Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)*	Box Qty	Case Qty
SWIVEL MOUNT							
	3/8"	8269957	SH-GST/CST 20	5/16 x 1-3/4"	2537 in 3000 psi concrete 1459 @ 45°off vertical in 3000 psi concrete 2852 in 6000 psi concrete 1636 @ 45°off vertical in 6000 psi concrete	25	125
	1/2"	8303957	SH-GST/CST 2.0	5/16 x 1-3/4"	2537 in 3000 psi concrete 1459 @ 45°off vertical in 3000 psi concrete 2852 in 6000 psi concrete 1636 @ 45°off vertical in 6000 psi concrete	25	125

#14 SH Orange Nut Driver Part # 8273910

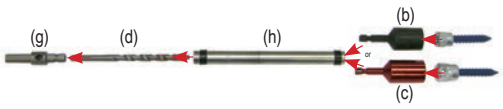
Note: UL Listed for wood - see page 5

* Tested in 3000 PSI concrete

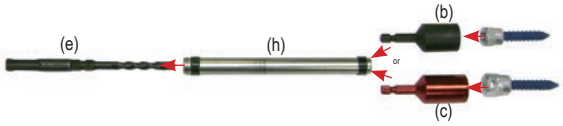
CONCRETE / WOOD INSTALLATION KIT

Application

Rotary Hammer Drill into concrete



Hammer Drill into concrete



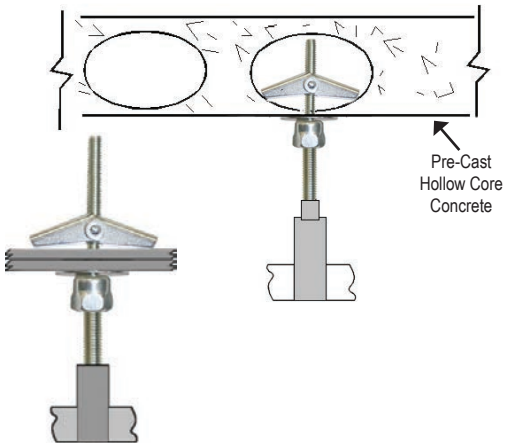
Part Number	Description	Each Qty
8122910	**Concrete Installation Kit (a)**	
	Kit includes the following items:	
8113910	#14 Black Nut Driver (b)	1
8114910	#14 SW Red Nut Driver (c)	1
8116910	#250 Bit (1/4") (d)	1
8117910	SDS Bit (1/4") (e)	1
8118910	7/32 Wood Bit (f)	1
8120910	HEX 250 Bit Receiver (1/4") (g)	1
8098910	SL 250 Sleeve (h)	1
8121910	SDS B250 Bit Receiver (1/4")*	1

**Only sold separately - not included in kit.*

ACCESSORIES

SAMMYS TOGGLE™

Application



Installation Steps

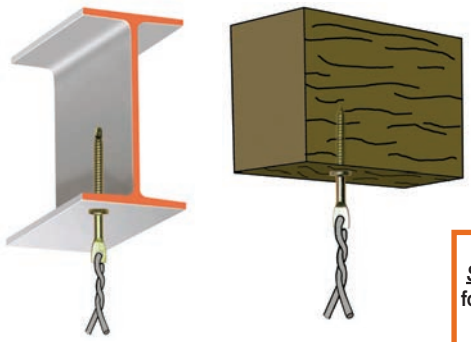
1. Pre-drill a 5/8" hole with a regular drill or hole saw.
2. Insert SST screw into #14 black nut driver. With wing nut and washer on bolt, insert wing nut through surface, and begin installation.
3. When bolt is secure and nut driver spins free, stop drill motor and remove.
4. SST screw is now ready to receive 1/4", 3/8", or Metric all thread rod or bolt stock.

#14 Black
Nut Driver
Part # 8113910

Rod Size	Part Number	Model	Screw Descriptions	Ultimate Pullout (lbs)	Box Qty	Case Qty
1/4"	8063925	SST 300	1/4 x 3"	450 (Lath & Plaster) 404 (2 Layers 5/8 Rock)	25	125
3/8"	8064925	SST 30	1/4 x 3"	450 (Lath & Plaster) 404 (2 Layers 5/8 Rock)	25	125

CEILING SCREWS

Application



Use the *Speedy Pole Tool*™ for easy installation of ceiling screws without ladders or scaffolding!
(see pg 13 for details)

Product Features

- 3/16" eyelet to accommodate common wire size.
- ICC approvals can be found at www.itwbuildex.com under Evaluation Report # ER-5367.

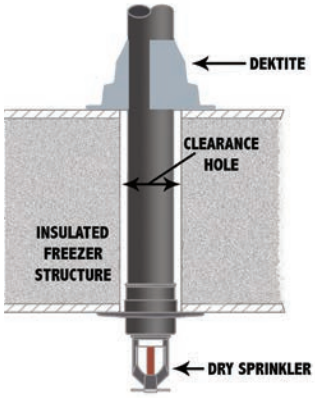
CWIT
Installation Tool
Part # 8110910

Approvals	Substrate	Part Number	Model	Point	Description	Overal Total Length	Ultimate Pullout (lbs)	Max Gauge	ICC Test Load (lbs)	Box Qty	Case Qty
ICC	STEEL	8107957	CWSD 1*	Teks	1/4 x 1"	2"	472 (20 ga)	16 ga.	170 (20 ga.)	25	125
ICC	STEEL WOOD	8190957	CWSD 15*	Gimlet Teks	1/4 x 1-1/2"	2-3/4"	472 (20 ga) 1393 (Fir)	20 ga.	170 (20 ga.)	25	125
ICC	STEEL	8108957	CWSD 2*	Teks	1/4 x 2"	3-1/4"	472 (20 ga)	16 ga.	170 (20 ga.)	25	125
ICC		8110910	CWIT Installation Tool								1

** Does not comply with ROHS requirements*

DEKTITE® PIPE FLASHING

Application



STAY UP TO CODE!
with a quicker, more efficient way to flash your refrigeration/freezer units.

Product Features

- Complies with NFPA 13 Code Changes.
- Flashing for dry pendant sprinklers subject to extreme temperature changes.
- One piece construction is easy to install.
- Pipe diameter markings ensure accurate fit.
- EPDM temperature range of -65°F to +250°F.

Part Number	Description	Pipe Outside Diameter	Dektite Base Diameter	Dektite Height	Box Qty
4001910	Mini	1/4" - 1-1/8"	3-1/2"	1-3/4"	20
4003910	1	1/4" - 2"	4-3/4"	3"	10
4004910	2	1-3/4" - 3-1/4"	6-1/4"	4"	10

SPEEDY POLE TOOL™ & UNIVERSAL SOCKET KIT

Universal Pole Tool Socket Kit (8129910) Includes:

- Adaptor Plug (a)
- Socket Driver for SAMMYS (b)
- Socket Driver for Ceiling Wire Screws (c)
- Socket Driver for 1/4" Standard Nut Drivers (d)
- Stud Plug for Viper or Ladd Powder Actuated Attachment (e)

(Items not sold seperately)

Watch a video demonstration at www.itwbuildex.com

Product Features

- The Pole Tool and Universal Socket Kit provide easy and safe installation for:
  - Sammys
  - Threaded Rod
  - Pencil Rod
  - Ceiling Screws
  - Jack Chain
  - Wire
  - Screws
- Ideal for retrofit and hard-to-reach projects in wood and steel.

Part Number	Description	Box Qty
8123910	Pole Tool 6' (3' - 6')	1
8124910	Pole Tool 12' (4' - 12')	1
8125910	Pole Tool 18' (6' - 18')	1
8126910	Pole Tool 24' (8' - 24')	1
Speedy Pole Tool Installation (specify choice when ordering pole tool)		
8127910	Sammys Socket Driver	1
8128910	Ceiling Wire Socket Driver for wire and chain	1
8129910	Universal Pole Tool Socket Kit	1

SPOT-RITE LEVEL™

Part Number	Model	Ea. Qty
8130910	Spot Rite Level	1

Product Features

- 1/2", 3/4", and 1" threading
- Magnetic strip for ease of use
- Pocket Sized
- Lightweight
- 3-vial design for measurement of 0°, 45°, and 90° angles

APPROVALS

Part Number	Model	Rod Size	Mount Direction	UL Max Pipe Size	UL Test Load (lbs)	UL Min Wood Thickness	FM Max Pipe Size	FM Test Load (lbs)	FM Min Wood Thickness
SAMMYS FOR WOOD - PIPE HANGER									
8007957	GST 10	3/8"	Vertical	CPVC 1-1/2"	300	1-1/2"			
8020957	SWG 10	3/8"	Horizontal	CPVC 1-1/2"	300	1-1/2"			
8008957	GST 20	3/8"	Vertical	2-1/2"	850	1-1/2"	4"	1475	1-1/2"
8068925	GST 20-SS	3/8"	Vertical	2-1/2"	850	1-1/2"			
8010957	GST 30	3/8"	Vertical	4"	1500	1-1/2"	4"	1475	1-1/2"
8009925	GST 25-380	3/8"	Vertical	4"	1500	1-1/2"			
8022925	SWG 25-380	3/8"	Horizontal	3-1/2" - 4"*	1500	1-1/2"			
8021957	SWG 20	3/8"	Horizontal	2-1/2" - 3"**	1050	1-1/2"			
8073925	SWG 20-SS	3/8"	Horizontal	2-1/2"	850	1-1/2"			
8269957	SH-GST/CST 20	3/8"	45° Angle off Vertical	2-1/2"	850	1-1/2"			
8269957	SH-GST/CST 20	3/8"	45° Angle off Vertical	4"	1500	1-1/2"			
8139957	SH-GST 20	3/8"	17° Angle off Vertical	3"	1050	1-1/2"	4"	1475	1-1/2"
SAMMYS FOR STEEL - PIPE HANGER						**Min Steel Thick**			**Max Steel Thick**
8038957	DSTR 1	3/8"	Vertical	4"	1500	.035"	4"	1475	.105"
8037957	DSTR 1-1/2	3/8"	Vertical	4"	1500	.035"	4"	1475	.105"
8039957	DSTR 516	3/8"	Vertical	4"	1500	.037"	4"	1475	.105"
8045957	DST 516	3/8"	Vertical	4"	1500	.188"	4"	1475	.188"
8046957	TEK 50	3/8"	Vertical	4"	1500	.250"	4"	1475	.188"
8055957	SWDR 1	3/8"	Horizontal	4"	1500	.037"	4"	1475	.060"
8056957	SWDR 516	3/8"	Horizontal	4"	1500	.037"	4"	1475	.060"
8054957	SWDR 1-1/2	3/8"	Horizontal	4"	1500	.037"	4"	1475	.060"
8137957	SH-DSTR 1	3/8"	17° Angle off Vertical	4"	1500	.035"	4"	1475	.105"
8268957	SH-TEK 50	3/8"	Vertical 70° Angle off Vertical	2-1/2" 4"	850 1500				
8150922	XP 20	3/8"	Vertical	2-1/2"	850	.027"	2" 4"	940 1475	.029" .105"
8153922	XP 35	3/8"	Vertical	4"	1500	.060"	2" 4"	940 1475	.029" .125"
8294922	SXP 20	3/8"	Vertical or up to 45°	2"	750	.027"	2"	635	.029"
8295922	SXP 35	3/8"	Vertical or up to 89°	3-1/2"	1250	.060"	2"	635	.029"
8293957	SWXP 35	3/8"	Horizontal	3-1/2"	1250	.060"			
SAMMYS FOR CONCRETE - PIPE HANGER									
8059957	CST 20	3/8"	Vertical				4"	1475	3000
8061957	SWC 20	3/8"	Horizontal				4"	1475	3000
8150922	XP 20	3/8"	Vertical	2-1/2"	850	Pre-Pour Structural @ 3000psi			
8150922	XP 20	3/8"	Vertical	2-1/2"	850	Post-Pour Range II LWC ≤ 35 PCF (lbs/ft^3)			

Part Number	Model	Rod Size	Mount Direction	UL Load Rating (lbs)	UL Min Steel Thickness
SAMMYS FOR STEEL - LUMINAIRE FITTING					
8150922	XP 20	3/8"	Vertical	185 250	.027" .035"
8153922	XP 35	3/8"	Vertical	185 250	.027" .035"
8181922	XP 200	1/4"	Vertical	185 250	.027" .035"
8294922	SXP 20	3/8"	Vertical 45°	170 80	.027" .027"
8295922	SXP 35	3/8"	Vertical 90°	250 80	.060" .060"
8293957	SWXP 35	3/8"	Horizontal	80	.060"

Part Number	Model	Rod Size	Mount Direction	UL Load Rating (lbs)	UL Min. Steel Thickness	Listed Application
SAMMYS FOR STEEL - CONDUIT, TUBING, AND CABLE						
8150922	XP 20	3/8"	Vertical	283	.027"	Max 4 trade size EMT, RMC, and IMC & 5 trade size rigid PVC conduit
8153922	XP 35	3/8"	Vertical	500	.060"	Max 4 trade size EMT & 6 trade sze RMC, IMC, and rigid PVC conduit
8294922	SXP 20	3/8"	Vertical	283	.027"	Max 4 trade size EMT, RMC, and IMC & 5 trade size rigid PVC conduit
8295922	SXP 35	3/8"	Vertical	500	.060"	Max 4 trade size EMT & 6 trade sze RMC, IMC, and rigid PVC conduit
8293957	SWXP 35	3/8"	Horizontal	500	.060"	Max 4 trade size EMT & 6 trade sze RMC, IMC, and rigid PVC conduit
8149957	CZ2000	1/4" or 3/8"	Onto Vertical Rod			UL Listed 4S16 - Cable Hanger, Cat. No. C-Z2000 Plenum Rated, Complies w/ NEC Standards

Sheet Steel Gauges

Gauge No.	22 ga.	20 ga.	18 ga.	16 ga.	14 ga.	12 ga.	1/8"	3/16"	1/4"
Nominal Decimal Equivalent	.030"	.036"	.048"	.060"	.075"	.105"	.125"	.188"	.250"

*SWG 25-380 Maximum pipe size in composite wood joist allowed by UL is 3-1/2"
*SWG 25-380 Maximum pipe size in wood timber or joist allowed by UL is 4"
**SWG 20 Maximum pipe size in composite wood joist allowed by UL is 2-1/2"
**SWG 20 Maximum pipe size in wood timber or joist allowed by UL is 3"

UL compliance with NEC Standards.
UL and FM tests were performed in compliance with NFPA 13 Standards.
Fastening requirement: 5 times weight of water-filled schedule 40 pipe plus 250 pounds.

SPECIAL NOTES

Engineering Note
In 1996, the anchors listed by UL were tested in plate steel that measured .188" and .118". Subsequent testing was done for z-purlin applications in May 1997 using (.037") or 20 gauge steel. Most recently in 2008, testing with the new Sammy X-Press® was completed using (.030") or 22 gauge steel metal deck.

Sammys® Nut Drivers
Special nut drivers were designed to be used with Sammys. When the appropriate nut drivers are used for installation, the driver spins freely on the screw after installation is complete and eliminates the expected wrist snap, reduces over-torque, and prevents screw failure.

Steel Screws
Due to variations in hardness of certain metals, it should be noted that our self-drilling screws for steel will experience different drill speeds. 500-1500 RPM drill speed should be used.

Metric Products
Metric versions of the Sammy anchors are available at www.itwbuildex.com

Sammys for Seismic
Please visit www.itwbuildex.com for our current Seismic product offerring.

Vibratory Environments
For attaching or anchoring in high vibratory environments, special care should be taken not just for building attachments but also for the hangers or assemblies being supported. Consult local code authorities for accepted anchoring devices.

Composite Joist/Truss
Truss manufacturers vary installation recommendations for composite joist. UL testing was completed to validate that Sammys and Sidewinders SWG 20 and SWG 25-380 can be installed into the top cord of a truss. Sammy GST 20 can be installed into the center of the lower cord of a composite joist. Penetration of the upright center web is permitted by some joist manufacturers. Consult truss manufacturer for recommended installation point.

Pre-drilling may be required by joist manufacturers. If so, pre-drill pilot hole 1/8" smaller than root diameter of fastener.

Consult the table below:

Model	Root Diameter	Hole Size
GST 20	.182"	1/8"
GST 25-380	.280"	7/32"
SWG 20	.182"	1/8"
SWG 25-380	.280"	7/32"

To increase efficiency of the installation process, sleeve tools, bit receivers, and wood bits are available for pre-drilling.

NFPA/NEC Standards
All UL and FM testing complies with NFPA 13 and NEC standards. Check with your local (AHJ) Authority Having Jurisdiction to confirm application and usage.

UL Listings / FM Approvals
UL and FM reports are available at www.itwbuildex.com

c UL us
LISTED
PIPE HANGER
ALSO LISTED AS CONDUIT AND CABLE HARDWARE
ALSO LISTED AS ANCHOR FOR LUMINAIRE
9R21

FM
APPROVED

Technical Drawings
Technical drawings are available and can be downloaded at www.itwbuildex.com in the following formats: .dwg, .dxf, and .igs.

Manufactured in the U.S.A. Products
MANUFACTURED U.S.A.

Contact Information
Technical Assistance: (800) BUILDEX Option #6 (x 3259)
Customer Service: (800) BUILDEX Option #1

CATALOG ISSUE

2012

BUILDING IDEAS THAT WORK FOR OVER 40 YEARS!

QUALITY

At ITW Buildex we pride ourselves on serving the construction industry for over 40 years with innovative, quality products that help our customers save time and money. We are commited to our customers by providing world class customer service and technical support. We are here to help!

ITW Buildex

1349 W. Bryn Mawr Ave.
Itasca, IL 60143
(P) 800-BUILDEX
(F) 630-595-3549
www.itwbuildex.com

Sammys®, Sammy X-Press®, Sammy X-Press It®, Sidewinder®, Sammy X-Press Swivel™, Sammy X-Press Sidewinder™, Tapcon®, Sammy Saddle™, Speedy Pole Tool™, Spot-Rite Level™, Dektite®, Swivel Head™, Sammys Toggle™, and Teks® are trademarks of Illinois Tool Works, Inc.

Dektite® is a registered trademark of Deks Industries Pty Ltd.

© 2012 ITW Buildex and Illinois Tool Works, Inc.

BX84_rev0712

HYDRAULIC CALCULATIONS

Hydraulic Overview

Job

Job Number: F24054	Designer: BKB
Job Name: LEGAL AID	Phone: 919.243.2464 FAX
Address 1: 1440 ROCK QUARRY RD.	State Certification/License Number: 16269FS
Address 2: RALEIGH, NC 27510	AHJ: CITY OF RALEIGH
Address 3	Job Site/Building: BEACON POINT

System

Density: 0.10gpm/ft²	Area of Application: 1500ft² (Actual 1522ft²)
Most Demanding Sprinkler Data: 5.6 K-Factor 19.60 at 12.250	Hose Streams: 100.00
Coverage Per Sprinkler: 196ft²	Number Of Sprinklers Calculated: 16 / Number Of Nozzles Calculated: 0
System Pressure Demand: 94.390	System Flow Demand: 340.35
Total Demand: 440.35 @ 94.390	Pressure Result: +12.425 (11.6%)

Supplies

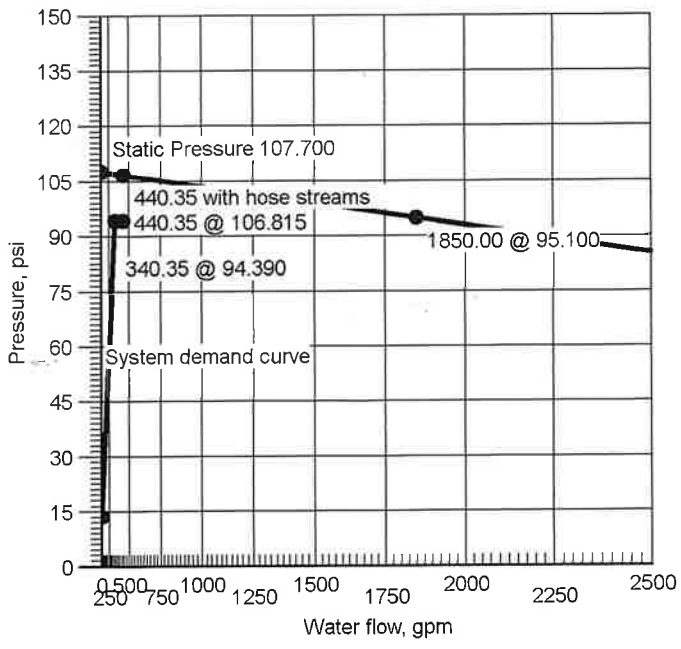
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)
18	Water Supply	1850.00	100.00	107.700	95.100

Check Point Gauges

Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)
BOR (17)	77.572	38.64	340.35

LEGAL AID PIPING 1

Water Supply at Node 18 (1850.00, 250.00, 107.700, 95.100)



Hydraulic Calculations

for

Project Name: LEGAL AID: (F24054)
Location: 1440 ROCK QUARRY RD., RALEIGH, NC 27510,
Drawing Name: LEGAL AID PIPING 1

Calculation Date: 5/16/2024

Design

Remote Area Number:	A
Remote Area Location:	CAFE
Occupancy Classification:	Light Hazard
Commodity Classification:	N/A
Density	0.10gpm/ft²
Area of Application:	1500ft² (Actual 1522ft²)
Coverage per Sprinkler:	196ft²
Type of sprinklers calculated:	Upright, Pendent
No. of sprinklers calculated:	16
No. of nozzles calculated:	0

In-rack Demand:	N/A gpm	at Node:	N/A		
Hose Streams:	100.00	at Node:	18	Type:	Allowance at Source

Total Water Required (including Hose Streams where applicable):
From Water Supply at Node 18: 440.35 @ 94.390 (Safety Margin = 12.425)
Type of System: WET
Volume of Dry/PreAction/Antifreeze/OtherAgent System: N/A

Name of Contractor:
Address: ,
Phone Number:
Name of designer: BKB
Authority Having Jurisdiction: CITY OF RALEIGH

Notes:

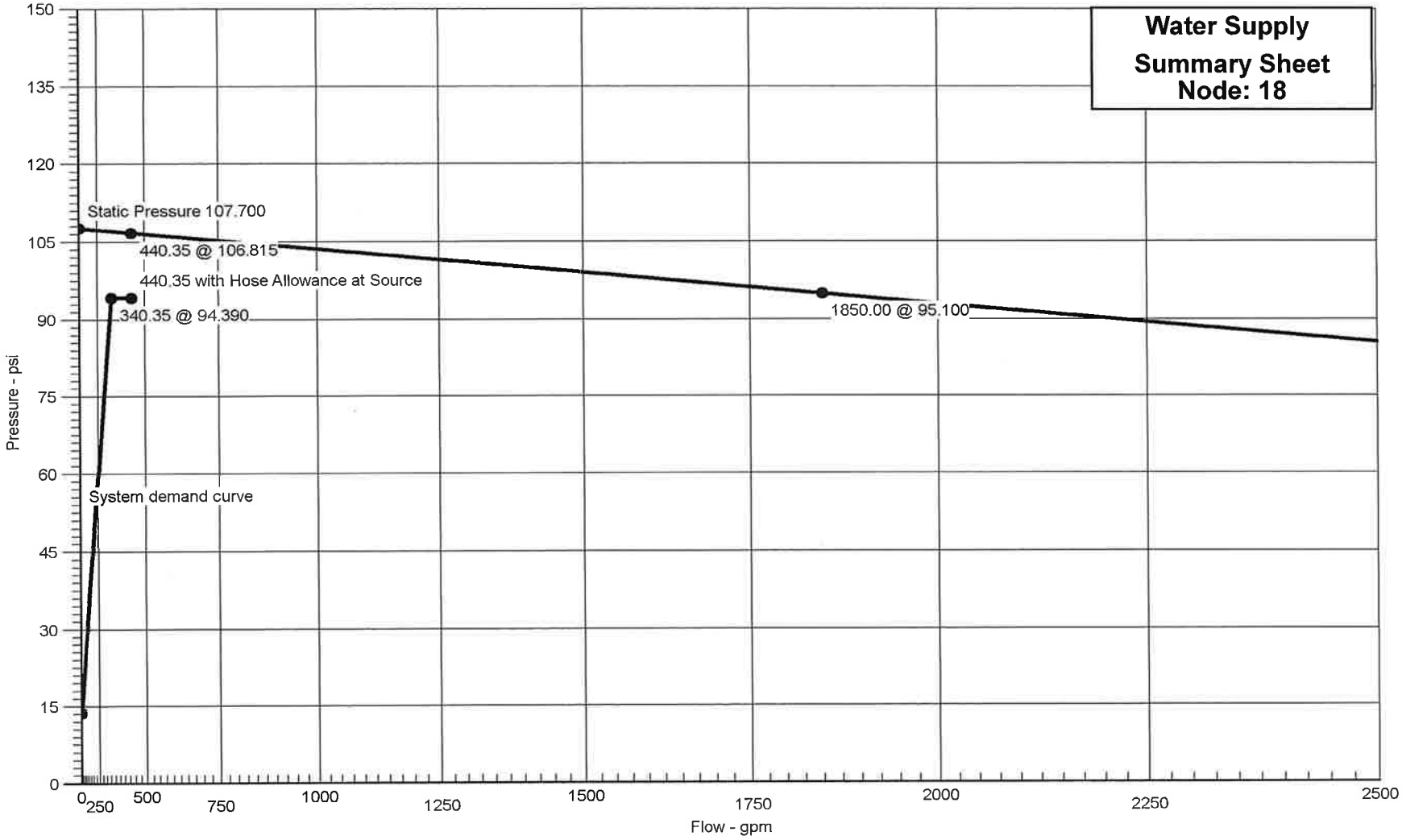
Automatic peaking results Left: 94.390 Right: 94.390

Hydraulic Graph

Job Name: LEGAL AID
Remote Area Number: A

N 1.85

Date: 5/16/2024



Supply: **Static:107.700**
Residual:95.100
Flowing:1850.00
Available Flow @ 20 PSI:5274.62

Summary Of Outflowing Devices

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
⇨ **Sprinkler**	**101**	**19.60**	**19.60**	**5.6**	**12.250**			
Sprinkler	102	19.92	19.60	5.6	12.647			
Sprinkler	103	19.98	19.60	5.6	12.727			
Sprinkler	104	20.23	19.60	5.6	13.046			
Sprinkler	105	20.55	19.60	5.6	13.469			
Sprinkler	106	20.61	19.60	5.6	13.547			
Sprinkler	107	20.65	19.60	5.6	13.598			
Sprinkler	108	20.73	19.60	5.6	13.705			
Sprinkler	109	20.74	19.60	5.6	13.719			
Sprinkler	110	21.00	19.60	5.6	14.065			
Sprinkler	111	21.10	19.60	5.6	14.200			
Sprinkler	112	21.61	19.60	5.6	14.897			
Sprinkler	113	23.13	19.60	5.6	17.053			
Sprinkler	114	23.22	19.60	5.6	17.198			
Sprinkler	115	23.61	19.60	5.6	17.781			
Sprinkler	116	23.67	19.60	5.6	17.861			

⇨ Most Demanding Sprinkler Data

Supply Analysis

Node	Name	Static (psi)	Residual (psi) @ Flow (gpm)		Available (psi) @ Total Demand (gpm)		Required Pressure (psi)
18	Water Supply	107.700	95.100	1850.00	106.815	440.35	94.390

Node Analysis

Node Number	Elevation (Foot)	Node Type	Pressure at Node (psi)	Discharge at Node (gpm)	Notes
18	-3'-0	Supply	94.390	340.35	
101	28'-11½	Sprinkler	12.250	19.60	
102	28'-9	Sprinkler	12.647	19.92	
103	28'-9	Sprinkler	12.727	19.98	
104	28'-11½	Sprinkler	13.046	20.23	
105	28'-9	Sprinkler	13.469	20.55	
106	28'-6	Sprinkler	13.547	20.61	
107	28'-9	Sprinkler	13.598	20.65	
108	28'-5½	Sprinkler	13.705	20.73	
109	28'-5½	Sprinkler	13.719	20.74	
110	28'-6	Sprinkler	14.065	21.00	
111	28'-6	Sprinkler	14.200	21.10	
112	28'-9½	Sprinkler	14.897	21.61	
113	22'-8	Sprinkler	17.053	23.13	
114	28'-6	Sprinkler	17.198	23.22	
115	22'-8	Sprinkler	17.781	23.61	
116	28'-9	Sprinkler	17.861	23.67	
1	25'-7		16.627		

Node Number	Elevation (Foot)	Node Type	Pressure at Node (psi)	Discharge at Node (gpm)	Notes
2	25'-7		16.672		
3	25'-7		16.697		
4	25'-7		17.188		
5	25'-7		17.301		
6	25'-7		18.292		
7	25'-7		18.375		
8	27'-11		18.416		
10	25'-1½		48.802		
11	25'-1½		48.935		
12	25'-1½		49.319		
13	25'-1½		50.729		
14	25'-1½		55.796		
15	11'-1½		71.699		
16	4'-0		76.189		
17	1'-0	Gauge	77.572		
19	25'-7		15.746		
20	25'-7		15.836		
21	25'-7		16.626		
22	27'-7½		14.782		
23	27'-7½		14.920		
25	25'-7		16.340		
26	25'-7		16.407		

Node Number	Elevation (Foot)	Node Type	Pressure at Node (psi)	Discharge at Node (gpm)	Notes
27	28'-0½		15.029		
28	28'-0½		15.172		
30	25'-7		19.906		
31	25'-7		21.008		
32	25'-7		18.429		
33	25'-7		19.680		
34	25'-7		19.762		
35	26'-2		20.315		
36	25'-1½		45.577		
37	25'-1½		48.692		
38	25'-1½		48.890		
39	25'-1½		48.274		
40	25'-1½		48.370		
42	25'-7		21.584		
43	25'-7		21.874		
45	25'-7		21.989		

Pipe Information

Node 1 / Node 2	Elev 1 / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
101	28'-11½	5.6	19.60	1	(See Notes)	14'-3½	120	12.250	• • • • • Route 1 • • • • • Sprinkler,
1	25'-7		19.60	1.0490		9'-0 23'-3½	0.125357	1.455 2.922	2E(2'-0), PO(5'-0)
1	25'-7		20.23	2½		8'-8½	120	16.627	Flow (q) from Route 4
2	25'-7		39.83	2.6350		8'-8½	0.005245	0.046	
2	25'-7		39.89	2½		1'-3½	120	16.672	Flow (q) from Route 2
3	25'-7		79.72	2.6350		1'-3½	0.018939	0.024	
3	25'-7		41.20	2½		12'-0	120	16.697	Flow (q) from Route 5
4	25'-7		120.92	2.6350		12'-0	0.040934	0.491	
4	25'-7		42.10	2½		1'-7	120	17.188	Flow (q) from Route 10
5	25'-7		163.03	2.6350		1'-7	0.071142	0.113	
5	25'-7		41.34	2½		9'-2	120	17.301	Flow (q) from Route 6
6	25'-7		204.37	2.6350		9'-2	0.108074	0.992	
6	25'-7		20.74	2½		0'-7½	120	18.292	Flow (q) from Route 9
7	25'-7		225.11	2.6350		0'-7½	0.129236	0.083	
7	25'-7			1½	(See Notes)	11'-4	120	18.375	PO(9'-11)
8	27'-11		36.45	1.6820		14'-10 26'-2½	0.039636	-0.998 1.038	E(4'-11½)
8	27'-11		23.22	1½	(See Notes)	271'-1	120	18.416	Flow (q) from Route 14
10	25'-1½		59.68	1.6820		24'-9 295'-10	0.098655	1.202 29.185	3E(4'-11½), PO(9'-11)
10	25'-1½			2½		12'-0	120	48.802	
11	25'-1½		59.68	2.6350		12'-0	0.011084	0.133	
11	25'-1½		57.10	2½		10'-0	120	48.935	Flow (q) from Route 16
12	25'-1½		116.78	2.6350		10'-0	0.038375	0.384	

Pipe Information

Node 1 / Node 2	Elev 1 (Foot) / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
12	25'-1½		54.29	2½	(See Notes)	1'-8	120	49.319	Flow (q) from Route 12
						16'-5½	0.077769		T(16'-5½)
13	25'-1½		171.07	2.6350		18'-1½		1.410	
13	25'-1½		169.29	2½	(See Notes)	1'-9½	120	50.729	Flow (q) from Route 17
						16'-5½	0.277667		PO(16'-5½)
14	25'-1½		340.35	2.6350		18'-3		5.067	
14	25'-1½			3	(See Notes)	51'-5½	120	55.796	
						48'-4½	0.098482	6.069	3E(9'-5), PO(20'-2)
15	11'-1½		340.35	3.2600		99'-10		9.833	
15	11'-1½			4	(See Notes)	5'-10	120	71.699	
						34'-0	0.035236	3.086	f, sCV(22'-0), BV(12'-0)
16	4'-0		340.35	4.0260		39'-10		1.404	
16	4'-0			4	(See Notes)	3'-0	120	76.189	
							0.026761	1.303	BOR
17	1'-0		340.35	4.2600		3'-0		0.080	
17	1'-0			6	(See Notes)	176'-10	140	77.572	
						179'-8	0.003040	1.734	
18	-3'-0		340.35	6.2800		356'-6		15.084	5E(22'-1), 2EE(11'-0½), BFP(-14.000), S, T(47'-3½)
			100.00					94.390	Hose Allowance At Source
18			440.35						Total(Pt) Route 1
102	28'-9	5.6	19.92	1	(See Notes)	4'-5	120	12.647	• • • • • **Route 2** • • • • •
						9'-0	0.129111	1.365	Sprinkler,
19	25'-7		19.92	1.0490		13'-5		1.734	2E(2'-0), PO(5'-0)
19	25'-7			1½		7'-0	120	15.746	
							0.012953		
20	25'-7		19.92	1.6820		7'-0		0.091	
20	25'-7		19.98	1½	(See Notes)	7'-11½	120	15.836	Flow (q) from Route 3
						9'-11	0.046832		PO(9'-11)
2	25'-7		39.89	1.6820		17'-10		0.836	
								16.672	Total(Pt) Route 2

Pipe Information

Node 1 / Node 2	Elev 1 / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes: Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
103	28'-9	5.6	19.98	1	(See Notes)	4'-5	120	12.727	• • • • • Route 3 • • • • • Sprinkler,
20	25'-7		19.98	1.0490		9'-0 13'-5	0.129870	1.365 1.744	2E(2'-0), PO(5'-0)
								15.836	Total(Pt) Route 3
104	28'-11½	5.6	20.23	1	(See Notes)	5'-0	120	13.046	• • • • • Route 4 • • • • • Sprinkler,
21	25'-7		20.23	1.0490		11'-0 16'-0	0.132876	1.455 2.124	3E(2'-0), PO(5'-0)
21	25'-7			2½		0'-7	120	16.626	
1	25'-7		20.23	2.6350		0'-7	0.001498	0.001	
								16.627	Total(Pt) Route 4
105	28'-9	5.6	20.55	1	(See Notes)	1'-1	120	13.469	• • • • • Route 5 • • • • • Sprinkler,
22	27'-7½		20.55	1.0490		5'-0 6'-1	0.136851	0.479 0.835	PO(5'-0)
22	27'-7½			1½		10'-0	120	14.782	
23	27'-7½		20.55	1.6820		10'-0	0.013729	0.137	
23	27'-7½		20.65	1½	(See Notes)	3'-1	120	14.920	Flow (q) from Route 7
3	25'-7		41.20	1.6820		14'-10 17'-11½	0.049714	0.885 0.892	E(4'-11½), PO(9'-11)
								16.697	Total(Pt) Route 5
106	28'-6	5.6	20.61	1	(See Notes)	4'-2	120	13.547	• • • • • Route 6 • • • • • Sprinkler,
25	25'-7		20.61	1.0490		7'-0 11'-2	0.137588	1.257 1.536	E(2'-0), PO(5'-0)
25	25'-7			1½		4'-10½	120	16.340	
26	25'-7		20.61	1.6820		4'-10½	0.013803	0.067	
26	25'-7		20.73	1½	(See Notes)	7'-11½	120	16.407	Flow (q) from Route 8
5	25'-7		41.34	1.6820		9'-11 17'-10	0.050028	0.893	PO(9'-11)
								17.301	Total(Pt) Route 6

Pipe Information

Node 1 / Node 2	Elev 1 (Foot) / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes: Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
107	28'-9	5.6	20.65	1	(See Notes)	1'-1½	120	13.598	• • • • • **Route 7** • • • • • Sprinkler,
23	27'-7½		20.65	1.0490		5'-0 / 6'-1½	0.138065	0.479 / 0.843	PO(5'-0)
								14.920	Total(Pt) Route 7
108	28'-5½	5.6	20.73	1	(See Notes)	3'-5½	120	13.705	• • • • • **Route 8** • • • • • Sprinkler,
26	25'-7		20.73	1.0490		7'-0 / 10'-5½	0.139067	1.248 / 1.455	E(2'-0), PO(5'-0)
								16.407	Total(Pt) Route 8
109	28'-5½	5.6	20.74	1	(See Notes)	14'-10½	120	13.719	• • • • • **Route 9** • • • • • Sprinkler,
6	25'-7		20.74	1.0490		9'-0 / 23'-10½	0.139199	1.249 / 3.324	2E(2'-0), PO(5'-0)
								18.292	Total(Pt) Route 9
110	28'-6	5.6	21.00	1	(See Notes)	0'-5½	120	14.065	• • • • • **Route 10** • • • • • Sprinkler,
27	28'-0½		21.00	1.0490		5'-0 / 5'-5½	0.142446	0.190 / 0.775	PO(5'-0)
27	28'-0½			1½		10'-0	120	15.029	
28	28'-0½		21.00	1.6820		10'-0	0.014291	0.143	
28	28'-0½		21.10	1½	(See Notes)	3'-6	120	15.172	Flow (q) from Route 11
4	25'-7		42.10	1.6820		14'-10 / 18'-4½	0.051747	1.066 / 0.950	E(4'-11½), PO(9'-11)
								17.188	Total(Pt) Route 10
111	28'-6	5.6	21.10	1	(See Notes)	0'-5½	120	14.200	• • • • • **Route 11** • • • • • Sprinkler,
28	28'-0½		21.10	1.0490		5'-0 / 5'-5½	0.143712	0.191 / 0.782	PO(5'-0)
								15.172	Total(Pt) Route 11
112	28'-9½	5.6	21.61	1	(See Notes)	15'-2	120	14.897	• • • • • **Route 12** • • • • • Sprinkler,
30	25'-7		21.61	1.0490		9'-0 / 24'-2	0.150227	1.377 / 3.632	2E(2'-0), PO(5'-0)
30	25'-7		201.96	2½		8'-7½	120	19.906	Flow (q) from Route 13
31	25'-7		223.58	2.6350		8'-7½	0.127614	1.102	

Pipe Information

Node 1 / Node 2	Elev 1 / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes: Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
31	25'-7			1½	(See Notes)	270'-1	120	21.008	PO(9'-11)
12	25'-1½		54.29	1.6820		69'-3½	0.082818	0.204	10E(4'-11½), PO(9'-11)
						339'-4½		28.107	
								49.319	Total(Pt) Route 12
113	22'-8	5.6	23.13	1	(See Notes)	6'-6½	120	17.053	• • • • • **Route 13** • • • • • Sprinkler,
32	25'-7		23.13	1.0490		9'-0	0.170227	-1.270	2E(2'-0), PO(5'-0)
						15'-6½		2.647	
32	25'-7		188.66	2½		10'-10	120	18.429	Flow (q) from Route 24
33	25'-7		211.78	2.6350		10'-10	0.115438	1.251	
33	25'-7		23.61	2½		0'-7	120	19.680	Flow (q) from Route 15
34	25'-7		235.40	2.6350		0'-7	0.140372	0.082	
34	25'-7			2½		1'-4½	120	19.762	
30	25'-7		201.96	2.6350		1'-4½	0.105733	0.144	
								19.906	Total(Pt) Route 13
114	28'-6	5.6	23.22	1	(See Notes)	0'-7	120	17.198	• • • • • **Route 14** • • • • • Sprinkler,
8	27'-11		23.22	1.0490		5'-0	0.171570	0.258	PO(5'-0)
						5'-7		0.960	
								18.416	Total(Pt) Route 14
115	22'-8	5.6	23.61	1	(See Notes)	5'-11	120	17.781	• • • • • **Route 15** • • • • • Sprinkler,
33	25'-7		23.61	1.0490		12'-0	0.176942	-1.270	E(2'-0), T(5'-0), PO(5'-0)
						17'-11		3.169	
								19.680	Total(Pt) Route 15
116	28'-9	5.6	23.67	1	(See Notes)	2'-6½	120	17.861	• • • • • **Route 16** • • • • • Sprinkler,
35	26'-2		23.67	1.0490		5'-0	0.177678	1.110	PO(5'-0)
						7'-6½		1.344	
35	26'-2		33.43	1½	(See Notes)	265'-2½	120	20.315	Flow (q) from Route 19
11	25'-1½		57.10	1.6820		44'-6½	0.090915	0.458	7E(4'-11½), PO(9'-11)
						309'-9		28.162	
								48.935	Total(Pt) Route 16

Pipe Information

Node 1 / Node 2	Elev 1 (Foot) / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes: Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
36	25'-1½		63.05	1½	(See Notes)	87'-4	120	45.577	• • • • • **Route 17** • • • • • Flow (q) from Route 20
37	25'-1½		32.49	1.6820		9'-11 97'-3	0.032038	3.115	PO(9'-11)
37	25'-1½		106.24	2½		3'-9	120	48.692	Flow (q) from Route 18
38	25'-1½		138.73	2.6350		3'-9	0.052779	0.198	
38	25'-1½		30.56	2½	(See Notes)	7'-7½	120	48.890	Flow (q) from Route 23
13	25'-1½		169.29	2.6350		16'-5½ 24'-1½	0.076280	1.839	T(16'-5½)
								50.729	Total(Pt) Route 17
39	25'-1½		55.20	2½		10'-0	120	48.274	• • • • • **Route 18** • • • • • Flow (q) from Route 22
40	25'-1½		55.20	2.6350		10'-0	0.009593	0.096	
40	25'-1½		51.04	2½		10'-0	120	48.370	Flow (q) from Route 21
37	25'-1½		106.24	2.6350		10'-0	0.032216	0.322	
								48.692	Total(Pt) Route 18
34	25'-7			1½	(See Notes)	9'-0½	120	19.762	• • • • • **Route 19** • • • • • PO(9'-11)
35	26'-2		33.43	1.6820		14'-10 23'-11	0.033774	-0.254 0.807	E(4'-11½)
								20.315	Total(Pt) Route 19
31	25'-7		54.29	2½		7'-6½	120	21.008	• • • • • **Route 20** • • • • • Flow (q) from Route 12
42	25'-7		169.29	2.6350		7'-6½	0.076280	-0.000 0.576	
42	25'-7			1½	(See Notes)	180'-8	120	21.584	PO(9'-11)
36	25'-1½		63.05	1.6820		37'-1½ 217'-9½	0.109219	0.204 23.789	5E(4'-11½), EE(2'-5½)
								45.577	Total(Pt) Route 20
42	25'-7		63.05	2½		9'-0	120	21.584	• • • • • **Route 21** • • • • • Flow (q) from Route 20
43	25'-7		106.24	2.6350		9'-0	0.032216	0.000 0.290	

Pipe Information

Node 1 / Node 2	Elev 1 (Foot) / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes: Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
43	25'-7			1½	(See Notes)	271'-8½	120	21.874	PO(9'-11)
						84'-2	0.073885	0.204	
40	25'-1½		51.04	1.6820		355'-10		26.292	T(9'-11), 2Z, 11E(4'-11½), PO(9'-11)
								48.370	Total(Pt) Route 21
43	25'-7		51.04	2½		12'-0	120	21.874	• • • • • **Route 22** • • • • • Flow (q) from Route 21
							0.009593		
45	25'-7		55.20	2.6350		12'-0		0.115	
45	25'-7			1½	(See Notes)	251'-0	120	21.989	PO(9'-11)
						54'-5½	0.085389	0.204	
39	25'-1½		55.20	1.6820		305'-5		26.081	T(9'-11), 5E(4'-11½), PO(9'-11)
								48.274	Total(Pt) Route 22
36	25'-1½		63.05	1½	(See Notes)	91'-1	120	45.577	• • • • • **Route 23** • • • • • T(9'-11), Flow (q) from Route 20 E(4'-11½), PO(9'-11)
						24'-9	0.028600	0.000	
38	25'-1½		30.56	1.6820		115'-10		3.313	
								48.890	Total(Pt) Route 23
7	25'-7		36.45	2½		0'-7	120	18.375	• • • • • **Route 24** • • • • • Flow (q) from Route 1
							0.093207		
32	25'-7		188.66	2.6350		0'-7		0.054	
								18.429	Total(Pt) Route 24

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

(Actual Inside Diameter / Schedule 40 Steel Pipe Inside Diameter) 4.87 = Factor

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Fittings Legend

ALV	Alarm Valve	AngV	Angle Valve	b	Bushing
BalV	Ball Valve	BFP	Backflow Preventer	BV	Butterfly Valve
C	Cross Flow Turn 90°	cplg	Coupling	Cr	Cross Run
CV	Check Valve	DelV	Deluge Valve	DPV	Dry Pipe Valve
E	90° Elbow	EE	45° Elbow	Ee1	11¼° Elbow
Ee2	22½° Elbow	f	Flow Device	fd	Flex Drop
FDC	Fire Department Connectic	fE	90° FireLock(TM) Elbow	fEE	45° FireLock(TM) Elbow
flg	Flange	FN	Floating Node	fT	FireLock(TM) Tee
g	Gauge	GloV	Globe Valve	GV	Gate Valve
Ho	Hose	Hose	Hose	HV	Hose Valve
Hyd	Hydrant	LtE	Long Turn Elbow	mecT	Mechanical Tee
Noz	Nozzle	P1	Pump In	P2	Pump Out
PIV	Post Indicating Valve	PO	Pipe Outlet	PrV	Pressure Relief Valve
PRV	Pressure Reducing Valve	red	Reducer/Adapter	S	Supply
sCV	Swing Check Valve	SFx	Seismic Flex	Spr	Sprinkler
St	Strainer	T	Tee Flow Turn 90°	Tr	Tee Run
U	Union	WirF	Wirsbo	WMV	Water Meter Valve
Z	Cap				

Hydraulic Overview

Job Number: F24054 - LEGAL AID
Report Description: Light Hazard (B)

Job

Job Number: F24054	Designer: BKB
Job Name: LEGAL AID	Phone: 919.243.2464 FAX
Address 1: 1440 ROCK QUARRY RD.	State Certification/License Number: 16269FS
Address 2: RALEIGH, NC 27510	AHJ: CITY OF RALEIGH
Address 3	Job Site/Building: BEACON POINT

System

Density: 0.10gpm/ft²	Area of Application: 1500ft² (Actual 975ft²)
Most Demanding Sprinkler Data: 5.6 K-Factor 19.60 at 12.250	Hose Streams: 100.00
Coverage Per Sprinkler: 196ft²	Number Of Sprinklers Calculated: 11 / Number Of Nozzles Calculated: 0
System Pressure Demand: 74.991	System Flow Demand: 233.20
Total Demand: 333.20 @ 74.991	Pressure Result: +32.180 (30.0%)

Supplies

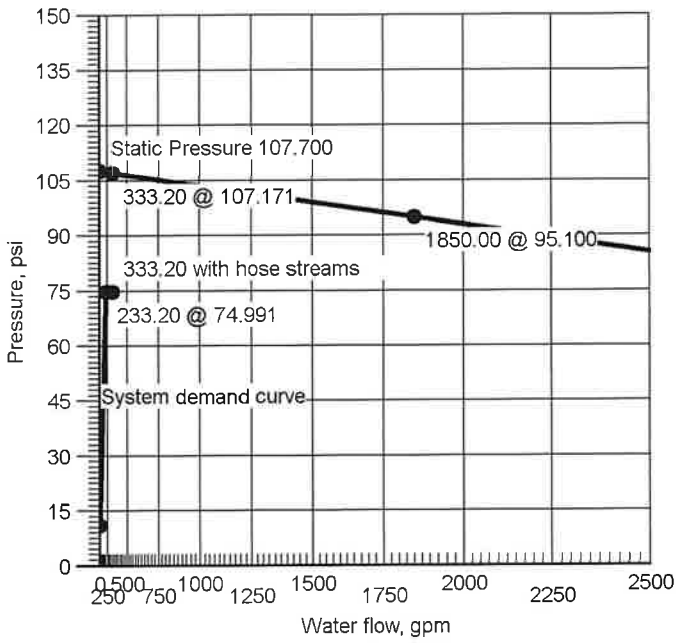
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)
18	Water Supply	1850.00	100.00	107.700	95.100

Check Point Gauges

Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)
BOR (17)	58.719	30.43	233.20

LEGAL AID PIPING 1

Water Supply at Node 18 (1850.00, 250.00, 107.700, 95.100)



Hydraulic Calculations

for

Project Name: LEGAL AID: (F24054)
Location: 1440 ROCK QUARRY RD., RALEIGH, NC 27510,
Drawing Name: LEGAL AID PIPING 1

Calculation Date: 5/16/2024

Design

Remote Area Number:	B
Remote Area Location:	OFFICE
Occupancy Classification:	Light Hazard
Commodity Classification:	N/A
Density	0.10gpm/ft²
Area of Application:	1500ft² (Actual 975ft²)
Coverage per Sprinkler:	196ft²
Type of sprinklers calculated:	Pendent
No. of sprinklers calculated:	11
No. of nozzles calculated:	0

In-rack Demand:	N/A gpm	at Node:	N/A		
Hose Streams:	100.00	at Node:	18	Type:	Allowance at Source

Total Water Required (including Hose Streams where applicable):
From Water Supply at Node 18: 333.20 @ 74.991 (Safety Margin = 32.180)
Type of System: WET
Volume of Dry/PreAction/Antifreeze/OtherAgent System: N/A

Name of Contractor:
Address: ,
Phone Number:
Name of designer: BKB
Authority Having Jurisdiction: CITY OF RALEIGH

Notes:

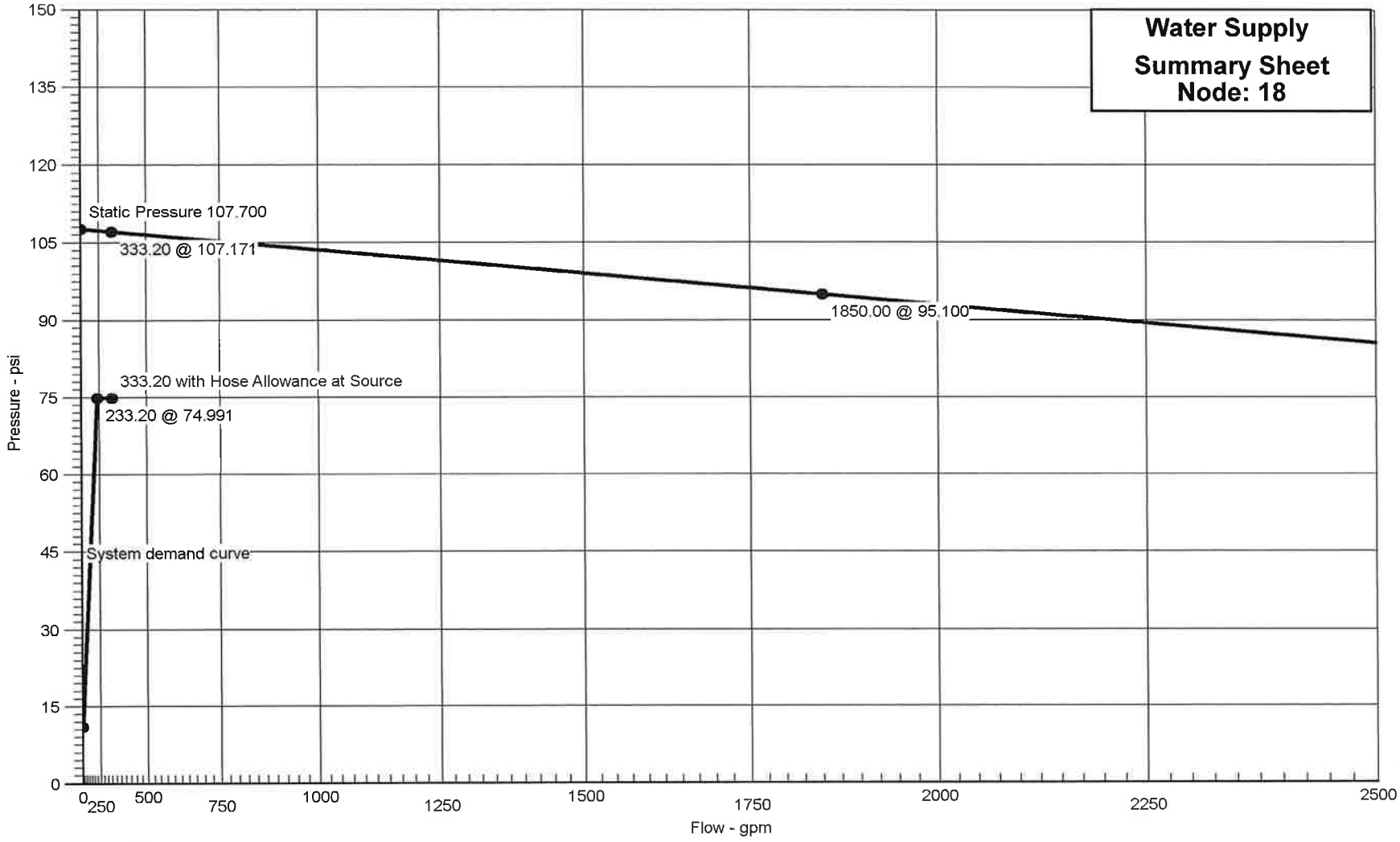
Automatic peaking results Left: 74.991 Right: 74.991

Hydraulic Graph

Job Name: LEGAL AID
Remote Area Number: B

N 1.85

Date: 5/16/2024



Supply: **Static:107.700**
Residual:95.100
Flowing:1850.00
Available Flow @ 20 PSI:5274.62

Summary Of Outflowing Devices

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
⇨ **Sprinkler**	**201**	**19.60**	**19.60**	**5.6**	**12.250**			
Sprinkler	202	19.60	19.60	5.6	12.255			
Sprinkler	203	19.68	19.60	5.6	12.351			
Sprinkler	204	19.81	19.60	5.6	12.517			
Sprinkler	205	19.88	19.60	5.6	12.608			
Sprinkler	206	21.56	19.60	5.6	14.822			
Sprinkler	207	21.57	19.60	5.6	14.839			
Sprinkler	208	21.58	19.60	5.6	14.855			
Sprinkler	209	21.76	19.60	5.6	15.098			
Sprinkler	210	23.13	19.60	5.6	17.066			
Sprinkler	211	25.01	19.60	5.6	19.943			

⇨ Most Demanding Sprinkler Data

Supply Analysis

Node	Name	Static (psi)	Residual (psi) @ Flow (gpm)		Available (psi) @ Total Demand (gpm)		Required Pressure (psi)
18	Water Supply	107.700	95.100	1850.00	107.171	333.20	74.991

Node Analysis

Node Number	Elevation (Foot)	Node Type	Pressure at Node (psi)	Discharge at Node (gpm)	Notes
18	-3'-0	Supply	74.991	233.20	
201	22'-8	Sprinkler	12.250	19.60	
202	22'-8	Sprinkler	12.255	19.60	
203	22'-8	Sprinkler	12.351	19.68	
204	22'-8	Sprinkler	12.517	19.81	
205	22'-8	Sprinkler	12.608	19.88	
206	22'-8	Sprinkler	14.822	21.56	
207	22'-8	Sprinkler	14.839	21.57	
208	22'-8	Sprinkler	14.855	21.58	
209	22'-8	Sprinkler	15.098	21.76	
210	22'-8	Sprinkler	17.066	23.13	
211	22'-8	Sprinkler	19.943	25.01	
7	25'-7		30.144		
9	27'-8½		17.687		
10	25'-1½		39.531		
11	25'-1½		39.569		
12	25'-1½		39.683		
13	25'-1½		40.119		

Node Number	Elevation (Foot)	Node Type	Pressure at Node (psi)	Discharge at Node (gpm)	Notes
14	25'-1½		42.637		
15	11'-1½		53.592		
16	4'-0		57.376		
17	1'-0	Gauge	58.719		
24	27'-8½		17.403		
29	27'-8½		17.435		
31	25'-7		29.992		
34	25'-7		30.106		
36	25'-1½		37.664		
37	25'-1½		38.619		
38	25'-1½		38.783		
39	25'-1½		38.191		
40	25'-1½		38.285		
41	27'-8½		17.662		
42	25'-7		29.810		
43	25'-7		29.419		
44	27'-8½		17.409		
45	25'-7		29.298		
46	27'-8½		17.664		
47	27'-8½		20.779		
48	27'-8½		20.804		
49	27'-8½		20.967		

Node Number	Elevation (Foot)	Node Type	Pressure at Node (psi)	Discharge at Node (gpm)	Notes
50	27'-8½		20.828		
51	27'-8½		21.195		

Pipe Information

Node 1 / Node 2	Elev 1 (Foot) / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes: Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
201	22'-8	5.6	19.60	1	(See Notes)	7'-9	120	12.250	• • • • • Route 1 • • • • •
						53'-0	0.125357	-2.180	Sprinkler,
9	27'-8½		19.60	1.0490		60'-9		7.617	3E(2'-0), PO(5'-0), fd(42'-0)
9	27'-8½		48.58	1½	(See Notes)	65'-11	120	17.687	Flow (q) from Route 3
						19'-9½	0.126235	0.910	
43	25'-7		68.18	1.6820		85'-8½		10.822	T(9'-11), PO(9'-11)
43	25'-7		56.72	2½		9'-0	120	29.419	Flow (q) from Route 8
							0.043461	-0.000	
42	25'-7		124.90	2.6350		9'-0		0.391	
42	25'-7			1½	(See Notes)	180'-8	120	29.810	PO(9'-11)
						37'-1½	0.035121	0.204	
36	25'-1½		34.15	1.6820		217'-9½		7.650	5E(4'-11½), EE(2'-5½)
36	25'-1½			1½	(See Notes)	87'-4	120	37.664	
						9'-11	0.009823		
37	25'-1½		17.15	1.6820		97'-3		0.955	PO(9'-11)
37	25'-1½		108.30	2½		3'-9	120	38.619	Flow (q) from Route 2
							0.043814		
38	25'-1½		125.45	2.6350		3'-9		0.164	
38	25'-1½		17.00	2½	(See Notes)	7'-7½	120	38.783	Flow (q) from Route 20
						16'-5½	0.055424		
13	25'-1½		142.45	2.6350		24'-1½		1.336	T(16'-5½)
13	25'-1½		90.75	2½	(See Notes)	1'-9½	120	40.119	Flow (q) from Route 12
						16'-5½	0.137958		
14	25'-1½		233.20	2.6350		18'-3		2.518	PO(16'-5½)
14	25'-1½			3	(See Notes)	51'-5½	120	42.637	
						48'-4½	0.048930	6.069	
15	11'-1½		233.20	3.2600		99'-10		4.886	3E(9'-5), PO(20'-2)
15	11'-1½			4	(See Notes)	5'-10	120	53.592	
						34'-0	0.017507	3.086	
16	4'-0		233.20	4.0260		39'-10		0.697	f, sCV(22'-0), BV(12'-0)
16	4'-0			4	(See Notes)	3'-0	120	57.376	
							0.013296	1.303	
17	1'-0		233.20	4.2600		3'-0		0.040	BOR

Pipe Information

Node 1 / Node 2	Elev 1 (Foot) / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes: Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
17	1'-0			6	(See Notes)	176'-10	140	58.719	
						179'-8	0.001510	1.734	
18	-3'-0		233.20	6.2800		356'-6		14.538	5E(22'-1), 2EE(11'-0½), BFP(-14.000), S, T(47'-3½)
			100.00					74.991	Hose Allowance At Source
18			333.20						Total(Pt) Route 1
202	22'-8	5.6	19.60	1	(See Notes)	7'-5	120	12.255	• • • • • **Route 2** • • • • • Sprinkler,
						51'-0	0.125408	-2.179	
24	27'-8½		19.60	1.0490		58'-5		7.327	2E(2'-0), PO(5'-0), fd(42'-0)
24	27'-8½			1½	(See Notes)	8'-0	120	17.403	
							0.003974	0.000	
29	27'-8½		10.52	1.6820		8'-0		0.032	Z
29	27'-8½		19.88	1½		8'-0	120	17.435	Flow (q) from Route 5
							0.028325	0.000	
41	27'-8½		30.40	1.6820		8'-0		0.227	
41	27'-8½		23.13	1½	(See Notes)	177'-5½	120	17.662	Flow (q) from Route 10
						64'-4	0.080692	1.113	
40	25'-1½		53.53	1.6820		241'-9½		19.510	Z, 11E(4'-11½), PO(9'-11)
40	25'-1½		54.77	2½		10'-0	120	38.285	Flow (q) from Route 6
							0.033381		
37	25'-1½		108.30	2.6350		10'-0		0.334	
								38.619	Total(Pt) Route 2
203	22'-8	5.6	19.68	1	(See Notes)	6'-3½	120	12.351	• • • • • **Route 3** • • • • • Sprinkler,
						51'-0	0.126318	-2.180	
44	27'-8½		19.68	1.0490		57'-3½		7.237	2E(2'-0), PO(5'-0), fd(42'-0)
44	27'-8½		9.09	1½		10'-0	120	17.409	Flow (q) from Route 18
							0.025582	-0.001	
46	27'-8½		28.77	1.6820		10'-0		0.256	
46	27'-8½		19.81	1½		0'-4	120	17.664	Flow (q) from Route 4
							0.067434	-0.000	
9	27'-8½		48.58	1.6820		0'-4		0.022	
								17.687	Total(Pt) Route 3

Pipe Information

Node 1 / Node 2	Elev 1 (Foot) / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes: Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
204	22'-8	5.6	19.81	1	(See Notes)	6'-3½	120	12.517	• • • • • **Route 4** • • • • •
46	27'-8½		19.81	1.0490		51'-0	0.127886	-2.180	Sprinkler,
						57'-3½		7.327	2E(2'-0), PO(5'-0), fd(42'-0)
								17.664	Total(Pt) Route 4
205	22'-8	5.6	19.88	1	(See Notes)	3'-5	120	12.608	• • • • • **Route 5** • • • • •
29	27'-8½		19.88	1.0490		51'-0	0.128739	-2.179	Sprinkler,
						54'-5		7.007	2E(2'-0), PO(5'-0), fd(42'-0)
								17.435	Total(Pt) Route 5
206	22'-8	5.6	21.56	1	(See Notes)	3'-5	120	14.822	• • • • • **Route 6** • • • • •
47	27'-8½		21.56	1.0490		51'-0	0.149527	-2.184	Sprinkler,
						54'-5		8.140	2E(2'-0), PO(5'-0), fd(42'-0)
47	27'-8½			1½		10'-0	120	20.779	
48	27'-8½		8.19	1.6820			0.002501		
						10'-0		0.025	
48	27'-8½		21.57	1½		6'-0	120	20.804	Flow (q) from Route 7
49	27'-8½		29.76	1.6820			0.027229		
						6'-0		0.163	
49	27'-8½		25.01	1½	(See Notes)	156'-8½	120	20.967	Flow (q) from Route 11
39	25'-1½		54.77	1.6820		34'-8	0.084163	1.118	
						191'-4½		16.106	5E(4'-11½), PO(9'-11)
39	25'-1½			2½		10'-0	120	38.191	
40	25'-1½		54.77	2.6350			0.009456		
						10'-0		0.095	
								38.285	Total(Pt) Route 6
207	22'-8	5.6	21.57	1	(See Notes)	3'-5	120	14.839	• • • • • **Route 7** • • • • •
48	27'-8½		21.57	1.0490		51'-0	0.149682	-2.184	Sprinkler,
						54'-5		8.148	2E(2'-0), PO(5'-0), fd(42'-0)
								20.804	Total(Pt) Route 7
208	22'-8	5.6	21.58	1	(See Notes)	3'-5	120	14.855	• • • • • **Route 8** • • • • •
50	27'-8½		21.58	1.0490		51'-0	0.149834	-2.184	Sprinkler,
						54'-5		8.157	2E(2'-0), PO(5'-0), fd(42'-0)

Pipe Information

Node 1 / Node 2	Elev 1 (Foot) / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes: Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
50	27'-8½		13.37	1½		10'-0	120	20.828	Flow (q) from Route 19
51	27'-8½		34.96	1.6820		10'-0	0.036681	0.367	
51	27'-8½		21.76	1½	(See Notes)	60'-3	120	21.195	Flow (q) from Route 9
45	25'-7		56.72	1.6820		19'-9½ 80'-1	0.089797	0.914 7.189	T(9'-11), PO(9'-11)
45	25'-7			2½		12'-0	120	29.298	
43	25'-7		56.72	2.6350		12'-0	0.010089	0.121	
								29.419	Total(Pt) Route 8
209	22'-8	5.6	21.76	1	(See Notes)	3'-5	120	15.098	• • • • • **Route 9** • • • • • Sprinkler,
51	27'-8½		21.76	1.0490		51'-0 54'-5	0.152103	-2.184 8.280	2E(2'-0), PO(5'-0), fd(42'-0)
								21.195	Total(Pt) Route 9
210	22'-8	5.6	23.13	1	(See Notes)	7'-3½	120	17.066	• • • • • **Route 10** • • • • • Sprinkler,
41	27'-8½		23.13	1.0490		9'-0 16'-3½	0.170349	-2.179 2.775	2E(2'-0), PO(5'-0)
								17.662	Total(Pt) Route 10
211	22'-8	5.6	25.01	1	(See Notes)	7'-3½	120	19.943	• • • • • **Route 11** • • • • • Sprinkler,
49	27'-8½		25.01	1.0490		9'-0 16'-3½	0.196755	-2.184 3.208	2E(2'-0), PO(5'-0)
								20.967	Total(Pt) Route 11
12	25'-1½		60.57 + 30.18	2½	(See Notes)	1'-8	120	39.683	• • • • • **Route 12** • • • • • Flow (q) from Route 13 and 16
13	25'-1½		90.75	2.6350		16'-5½ 18'-1½	0.024072	0.436	T(16'-5½)
								40.119	Total(Pt) Route 12
10	25'-1½		30.51	2½		12'-0	120	39.531	• • • • • **Route 13** • • • • • Flow (q) from Route 14
11	25'-1½		30.51	2.6350		12'-0	0.003203	0.038	
11	25'-1½		30.06	2½		10'-0	120	39.569	Flow (q) from Route 15
12	25'-1½		60.57	2.6350		10'-0	0.011393	0.114	
								39.683	Total(Pt) Route 13

Pipe Information

Node 1 / Node 2	Elev 1 / Elev 2 (Foot)	K-Factor	Flow added this step (q) / Total Flow (Q)	Nominal ID / Actual ID	Fittings & Devices / Equiv. Length (Foot)	Length (Foot) / Fitting (Foot) / Total (Foot)	C Factor / Pf Friction Loss Per Unit (psi)	Total(Pt) / Elev(Pe) / Friction(Pf)	Notes Fitting/Device (Equivalent Length) Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
34	25'-7		60.57	2½		12'-0	120	30.106	• • • • • **Route 14** • • • • •
									Flow (q) from Route 17
7	25'-7		30.51	2.6350		12'-0	0.003203	0.038	
7	25'-7			1½	(See Notes)	282'-5	120	30.144	PO(9'-11)
						39'-7		0.204	
10	25'-1½		30.51	1.6820		322'-0½	0.028513	9.182	4E(4'-11½), PO(9'-11)
								39.531	Total(Pt) Route 14
34	25'-7		60.57	1½	(See Notes)	274'-3	120	30.106	• • • • • **Route 15** • • • • •
						59'-5		0.204	PO(9'-11), Flow (q) from Route 17
11	25'-1½		30.06	1.6820		333'-8	0.027749	9.259	8E(4'-11½), PO(9'-11)
								39.569	Total(Pt) Route 15
42	25'-7		34.15	2½		7'-6½	120	29.810	• • • • • **Route 16** • • • • •
								0.000	Flow (q) from Route 1
31	25'-7		90.75	2.6350		7'-6½	0.024072	0.182	
31	25'-7			1½	(See Notes)	270'-1	120	29.992	PO(9'-11)
						69'-3½		0.204	
12	25'-1½		30.18	1.6820		339'-4½	0.027953	9.487	10E(4'-11½), PO(9'-11)
								39.683	Total(Pt) Route 16
31	25'-7		30.18	2½		10'-0	120	29.992	• • • • • **Route 17** • • • • •
									Flow (q) from Route 16
34	25'-7		60.57	2.6350		10'-0	0.011393	0.114	
								30.106	Total(Pt) Route 17
24	27'-8½		10.52	1½		2'-0	120	17.403	• • • • • **Route 18** • • • • •
								-0.000	Flow (q) from Route 2
44	27'-8½		9.09	1.6820		2'-0	0.003035	0.006	
								17.409	Total(Pt) Route 18
47	27'-8½		8.19	1½		8'-0	120	20.779	• • • • • **Route 19** • • • • •
									Flow (q) from Route 6
50	27'-8½		13.37	1.6820		8'-0	0.006201	0.050	
								20.828	Total(Pt) Route 19
36	25'-1½			1½	(See Notes)	91'-1	120	37.664	• • • • • **Route 20** • • • • •
						24'-9		0.000	T(9'-11)
38	25'-1½		17.00	1.6820		115'-10	0.009662	1.119	E(4'-11½), PO(9'-11)

Pipe Information

Node 1	Elev 1 (Foot)	K-Factor	Flow added this step (q)	Nominal ID	Fittings & Devices	Length (Foot)	C Factor	Total(Pt)	Notes
						Fitting (Foot)		Elev(Pe)	Fitting/Device (Equivalent Length)
Node 2	Elev 2 (Foot)		Total Flow (Q)	Actual ID	Equiv. Length (Foot)	Total (Foot)	Pf Friction Loss Per Unit (psi)	Friction(Pf)	Fixed Pressure Losses, when applicable, are added directly to (Pf) and shown as a negative value.
								38.783	Total(Pt) Route 20

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

(Actual Inside Diameter / Schedule 40 Steel Pipe Inside Diameter) 4.87 = Factor

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Fittings Legend

ALV	Alarm Valve	AngV	Angle Valve	b	Bushing
BalV	Ball Valve	BFP	Backflow Preventer	BV	Butterfly Valve
C	Cross Flow Turn 90°	cplg	Coupling	Cr	Cross Run
CV	Check Valve	DelV	Deluge Valve	DPV	Dry Pipe Valve
E	90° Elbow	EE	45° Elbow	Ee1	11¼° Elbow
Ee2	22½° Elbow	f	Flow Device	fd	Flex Drop
FDC	Fire Department Connectic	fE	90° FireLock(TM) Elbow	fEE	45° FireLock(TM) Elbow
flg	Flange	FN	Floating Node	fT	FireLock(TM) Tee
g	Gauge	GloV	Globe Valve	GV	Gate Valve
Ho	Hose	Hose	Hose	HV	Hose Valve
Hyd	Hydrant	LtE	Long Turn Elbow	mecT	Mechanical Tee
Noz	Nozzle	P1	Pump In	P2	Pump Out
PIV	Post Indicating Valve	PO	Pipe Outlet	PrV	Pressure Relief Valve
PRV	Pressure Reducing Valve	red	Reducer/Adapter	S	Supply
sCV	Swing Check Valve	SFx	Seismic Flex	Spr	Sprinkler
St	Strainer	T	Tee Flow Turn 90°	Tr	Tee Run
U	Union	WirF	Wirsbo	WMV	Water Meter Valve
Z	Cap				

WATER TEST

Raleigh

TEST LOCATION

Address/Location Description 1440 Rock Quarry Rd, Raleigh
Test hydrant Facility ID WHYD 177168
Flow hydrant Facility ID WHYD 177167

APPLICATION INFORMATION

Name J&D Sprinkler Co., Inc.
Address 315 W. Main St, Clayton, NC 27520
Contact Person Farrin Dunn Phone (919) 553-2356
Email farrin@jdsprinkler.com

SYSTEM INFORMATION

Test Date 04/29/2022
Time of Test 10:05 am
Nearest Elevated Tank Chamberlain
Test Hydrant Elevation +/- 223.49'
Main Size 8" DIP
Pressure Zone 495'
Tank Hydraulic Grade 484.35'
Use 20ft below pressure zone (tank overflow) for design*
Pump Info N/A
Theoretical Pressure 113.0 psi

RESULTS

Static Pressure 107.7 psi
Residual Pressure 95.1 psi
Outlet Diameter 2 1/2 inches
Orifice Coefficient 1.38

Number of Outlets Flowing 2
Flow Hydrant Discharge Pressure 32, 31 psi
Volume of Discharge 932 + 918 = 1,850 gpm
Water usage during test 2,500 Total Gal

Test Completed by: Eiji Fujino and Michael Williams
Testing Company: Engineering Planning and Management

Testing Equipment HydroFlow Hose Monster
(Make and Model)

SEAL (if applicable)

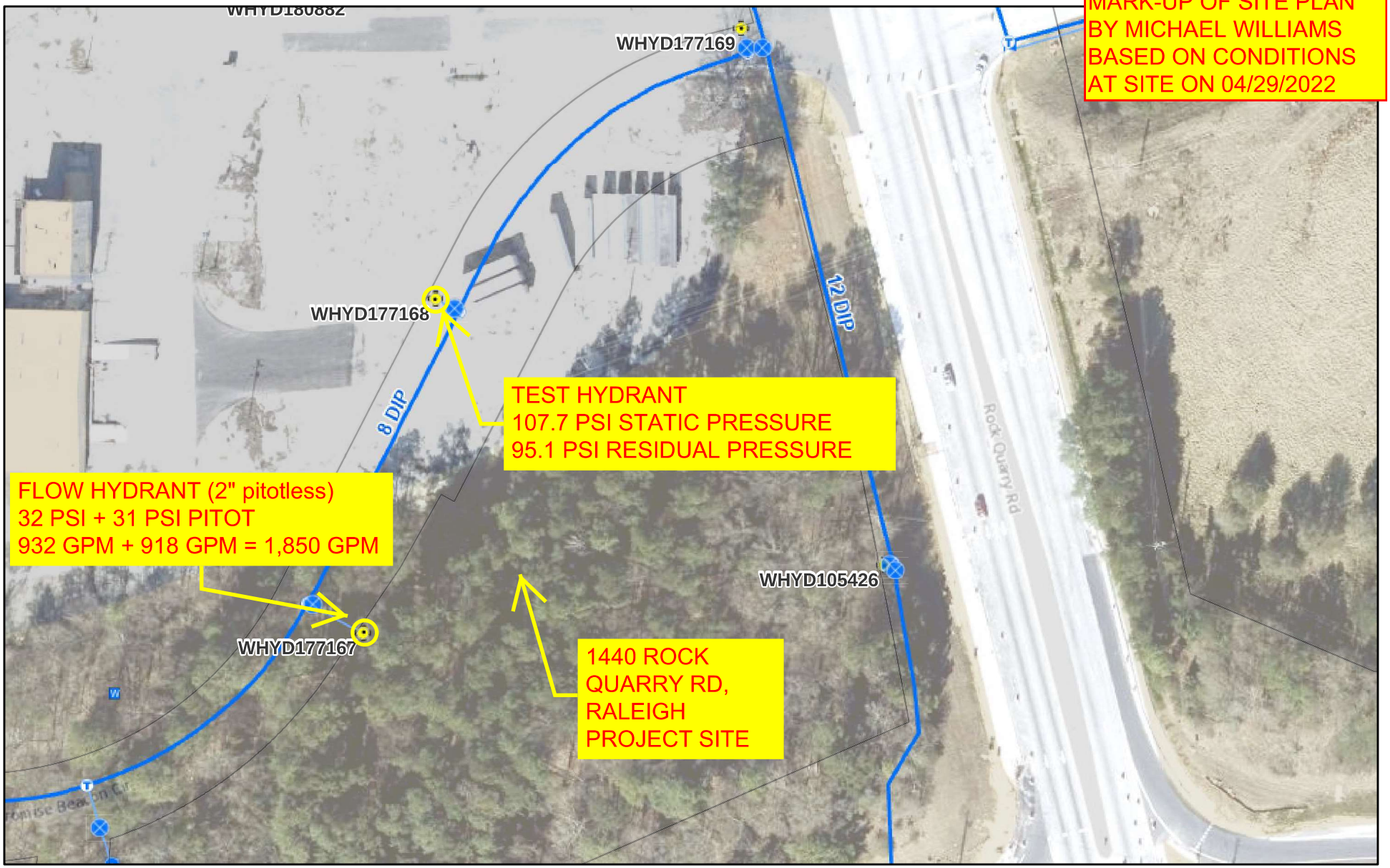
NORTH CAROLINA PROFESSIONAL SEAL 049848 ENGINEER RYAN ROGAN
5/2/2022

Notes:

Please attach the following supporting documentation to this form;
Labeled map of location of test identifying test hydrant and flow hydrant
Calculation demonstrating how the discharge flow was determined
Calculation demonstrating the available fire flow at a residual pressure of 20 psi
Printout of any recorded data supporting the static and residual pressure at the test hydrant.
Printout of any recorded data supporting the discharge pressure of the flow hydrant.
See NFPA 291 for additional information about completing fire hydrant flow tests
*To maintain system water quality, storage tanks may be maintained as low as 20' below overflow.

updated November 2021

1440 Rock Quarry Rd



4/29/2022, 6:42:55 AM

1:1,200

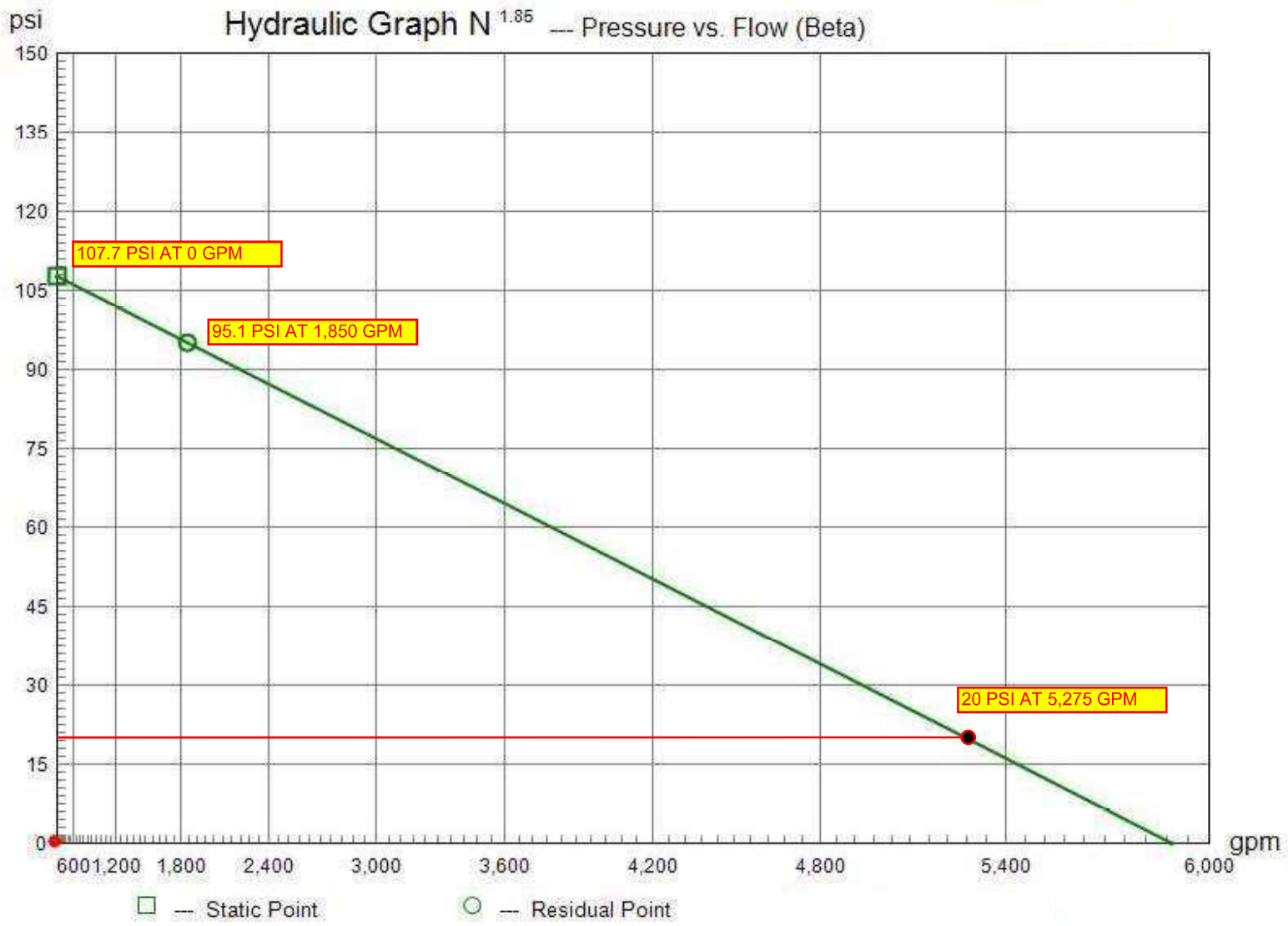
0 0.01 0.02 0.04 mi

0 0.02 0.03 0.06 km

City of Raleigh GIS

Raleigh Water

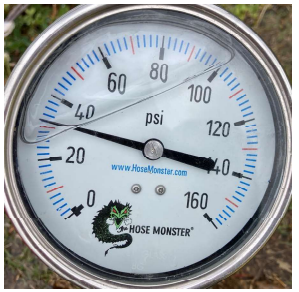
This maps and data is produced for information purposes only and is NOT a survey. No warranties, expressed or implied, are provided for the data therein, its use or its interpretation.



STATIC PRESSURE:
107.7 PSI

RESIDUAL PRESSURE:
95.1 PSI

FLOW:
32 PSI PITOT



FLOW:
31 PSI PITOT

2" PITOTLESS NOZZLE™

PN2THD

FLOW CHART

10 - 40 PSI	2 1/2" Hose Monster Model II	Open Atmosphere		41 - 70 PSI	2 1/2" Hose Monster Model II	Open Atmosphere			Key Flow Test Points	2 1/2" Hose Monster Model II	Open Atmosphere	
PSI	GPM	GPM		PSI	GPM	GPM			GPM	PSI	PSI	
10	521	529		41	1055	1071			500	9.5	9.1	
11	547	555		42	1068	1084			562.5	11.7	11.3	
12	571	579		43	1081	1096			750	20.7	20.1	
13	594	603		44	1093	1109			1000	36.8	35.8	
14	617	626		45	1106	1122			1125	46.6	45.3	
15	638	648		46	1118	1134			1500	82.8	80.5	
16	659	669		47	1130	1146						
17	679	689		48	1142	1158						
18	699	709		49	1154	1170						
19	718	729		50	1165	1182						
20	737	748		51	1177	1194						
21	755	766		52	1188	1206						
22	773	784		53	1200	1217						
23	790	802		54	1211	1229						
24	807	819		55	1222	1240						
25	824	836		56	1233	1251						
26	840	853		57	1244	1262						
27	856	869		58	1255	1273						
28	872	885		59	1266	1284						
29	887	900		60	1277	1295						
30	903	916		61	1287	1306						
31	918	931		62	1298	1317						
32	932	946		63	1308	1327						
33	947	960		64	1318	1338						
34	961	975		65	1329	1348						
35	975	989		66	1339	1358						
36	989	1003		67	1349	1369						
37	1002	1017		68	1359	1379						
38	1016	1031		69	1369	1389						
39	1029	1044		70	1379	1399						
40	1042	1057										

The readings on this chart are based on which device the Pitotless Nozzle is connected to.
It is the user's responsibility to verify that the correct chart and column is being used.

- **2 ½" Hose Monster Model II or Flusher with flow splitter (HM2H, HM2HF).** Use this column if the Pitotless Nozzle is connected to the 2 ½" Hose Monster or Flusher. The built-in pitot or flow splitter must be installed for accuracy. If you do not have the built-in pitot or flow splitter, please contact us.
- **Open Atmosphere.** Use this column when the Pitotless Nozzle is connected directly to a test header or hydrant flowing openly to atmosphere.

This chart is FM Approved for flow rate accuracy. Please call us or instruct the Authority Having Jurisdiction to call us if there are any questions. Additional copies of flow charts are available at:
www.hosemonster.com/literature.html

FM APPROVED

The HOSE MONSTER COMPANY
Division of Hydro Flow Products, Inc.

Updated Jun. 2015

MANUFACTURED BY:
Hydro Flow Products, Inc.
888.202.9987 TOLL FREE
847.434.0073 FAX
Service@FlowTest.com EMAIL
www.HoseMonster.com

U. S. Patent # 6,874,375

Pitotless Nozzle™ Threaded

INSTRUCTIONS

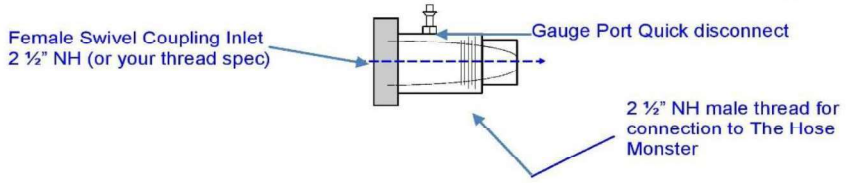
US Patent 6,874,375

The Pitotless Nozzle Threaded (PN#THD) must be used with the 2 ½" Hose Monster Model II (HM2H, HM2HF) **or** attached directly to a hydrant or test header valve discharging into open atmosphere. *Note: If you intend to use the Pitotless Nozzle with the Little Hose Monster (HML), then a Pitotless Nozzle Grooved (PN#GRV) is required. Do not use the Pitotless Nozzle Threaded (PN#THD) with the Little Hose Monster. Call us if you are considering a configuration not listed here.*

SETUP

The gauge connection on the Pitotless Nozzle is a factory-installed male end of a quick disconnect coupling. One female counterpart is included and additional ones can be purchased separately. Attach the female end of the quick disconnect coupling directly to the gauge or remote reader adapter and use the quick disconnect feature to attach and remove. Do not remove the male quick disconnect from the Pitotless Nozzle as it will damage the threads on the Pitotless Nozzle.

We recommend a gauge with an accuracy rating of ½% or better and of a suitable range.



Using the Pitotless Nozzle with the 2 ½" Hose Monster® or Flusher

Insert the male outlet end of the Pitotless Nozzle into the swivel coupling of the Hose Monster. Hand-tighten plus about a quarter turn using a common rocker lug spanner wrench on the swivel coupling and a hole type spanner wrench (WSPA104) for a holdback. Attach the male end of a hose into the swivel coupling on the Pitotless Nozzle, hand-tighten plus about a quarter turn using spanner wrenches. The pitot/flow splitter must be installed on either unit in order to collect accurate flow rates.

If using the Pitotless Nozzle without the Hose Monster

The Pitotless Nozzle must be attached securely to a pump test header valve or hydrant. Secure the female swivel coupling of the Pitotless Nozzle directly to a hydrant nozzle or test header valve. The Pitotless Nozzle points in the direction the water will flow. Clear water discharge path.

Flow Charts

Pitotless Nozzle flow charts must be used to determine discharge flow rate. The use of flow charts of a different device or size will result in incorrect readings. Within the flow chart is a column for "2 ½" Hose Monster Model II" and for "Open Atmosphere". Use the "2 ½" Hose Monster Model II" flows if the Pitotless Nozzle is attached to a 2 ½" Hose Monster Model II. Use the "Open Atmosphere" flows if the Pitotless Nozzle is attached directly on a hydrant or test header valve discharging out into the open. Flow charts are provided with the Pitotless Nozzle and additional copies are available on our website at **www.HoseMonster.com/literature.html**

WARNING:

- **Do not** attach the Pitotless Nozzle to the end of a hose unless the Hose Monster is attached to it or unless it is permanently secured.
- **Do not** attach a hose to the male outlet end of the Pitotless Nozzle under any circumstance. The resulting backpressure will distort flow rate measurement.
- **Do not** remove the quick disconnect gauge port fitting. The aluminum threads will be damaged. Contact Hydro Flow Products directly for any repairs.

The HOSE MONSTER COMPANY
Division of Hydro Flow Products, Inc.

MANUFACTURED BY:
Hydro Flow Products, Inc.
(888) 202-9987 Toll Free
(847) 434-0073 Fax
Service@FlowTest.com
www.HoseMonster.com

1440 Rock Quarry Rd, Raleigh

STATIC PRESSURE
107.7 PSI

RESIDUAL PRESSURE
95.1 PSI